DOCUMENT RESUME

ED 022 039 VT 005 534

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CONCEPT FORMATION AND THE HOME ECONOMICS CURRICULUM. INTER-UNIVERSITY PROJECT ONE PUBLICATION SERIES.

Cornell Univ., Ithaca, N.Y.
Spons Agency- Ford Foundation, New York, N.Y.
Pub Date Apr 65
Note- 69p.
Available from- Project One Publication Office, 320 Wait Avenue, Ithaca, New York 14850 (single copies without harge).
EDRS Price MF-$0.50 HC-$2.84
Descriptors- *COGNITIVE PROCESSES, *CONCEPT FORMATION, *CONCEPT TEACHING, CURRICULUM DEVELOPMENT, *HOME ECONOMICS EDUCATION, HOME MANAGEMENT, LEARNING PROCESSES, *LEARNING THEORIES

Principles of concept formation extracted from an extensive review of theoretical and empirical work in psychology, and their relationship to home economics are presented. The present attempts of home economics educators to identify the basic concepts of the field and organize curriculums around them are potentially fruitful, both for students and for the image of home economics. However, these educators have limited the meaning of "concept" in their use of the "concept approach." Curriculum groups have thus far been concerned only with concepts as products while experimental psychologists have investigated the process of learning concepts. The home economics teacher would profit from the curriculum in which the two approaches were unified. Only national cooperation in building high school home economics curriculums would make possible the development of correlated textbooks, pamphlets, films, filmstrips, tapes, demonstration equipment and other illustrative materials. Topics discussed are (1) meanings of concept, and the task, methodological, organismic, and strategy variables in concept learning, (2) the use of the concept approach in improving high school curriculums in the physical, biological, and social sciences and mathematics, and (3) sample lessons in the area of management of personal and family life illustrating the "conceptual mode" of teaching. (FP)

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Inter-University Project One

Publication Series

1 CONCEPT FORMATION AND THE HOME ECONOMICS CURRICULUM

2 Patricia Carlin White

April 1965

3 Inter-University Project One,
at Cornell University, the University of Buffalo,
the University of Rochester, and Syracuse University,
is supported in part by
The Ford Foundation

VT005534
ED022039

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FOREWARD

Two of Project One's many purposes are represented in this essay: to coordinate and integrate work in allied disciplines, such as psychology, with the subject to be taught, and to show teachers and administrators how they can adopt certain technological advanced and behavioral research findings to the improvement of pupils' learning. From an extensive review of theoretical and empirical work in psychology, the author has extracted the principles of concept formation and brought them to bear on one of the major practical arts of the high school curriculum: home economics. The principles are amply illustrated with procedures useful to the practicing school teacher.

Mrs. White, who is now using her ideas while teaching in the public schools of Pittsburgh, Pennsylvania, received both her B.A. and M.Ed. with honors from Cornell University. She did practice teaching in Ithaca High School, Boynton Junior High, and Letchworth Central School.

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CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

Home economics educators reflect a growing concern for the integrity of their field in the recent steps that state, regional, and national groups have taken to identify the basic concepts of home economics. (58: 539) In a report on "Selected Issues and Problems in Secondary Education" in the professional publication, the Journal of Home Economics, the author discusses this concern.

> The Home Economics Education Branch of the U. S. Office of Education has provided leadership in the task of identifying the fundamental principles, the central concepts, and the major ideas in the various areas of home economics. Preliminary work was begun in February 1961. Since that time, discussion at several regional and national meetings of home economics educators has centered on the 'concept approach' to curriculum development. (54: 13).

In a series of talks on "Education in a World of Change," delivered at the 1962 annual meeting of the American Home Economics Association, the speaker predicted that,

> ... the influence of home economics on the future might depend upon the extent to which the concepts, along with the skills and values of our field can be defined... Concepts, skills, and values are being increasingly recognized as the structure of the curriculum for home economics in high schools. In achieving depth, it is not necessary to eliminate the 'how' in order to answer the 'why'. (58: 540)

Homemaking skills must always occupy a place in the high school home economics curriculum, but another quote from an article entitled "The Place of Home Economics in American Society" serves to clarify the change that the new curriculum approach represents:

> A continuation of the lessening of emphasis upon skills seems to be in order in educational programs, especially at the secondary school level. (2: 450)

This decreasing emphasis on skills, and the growing emphasis on concepts in home economics is certainly defensible in view of rapidly changing times which may render a skill obsolete in a matter of years. Concepts provide a framework for thinking, for meeting new situations, for acquiring new knowledge.

The present attempts of home economics educators to identify the basic concepts of the field and organize curriculums around these concepts are potentially fruitful, both for students in home economics courses and for the image that home economics presently has. However, the position to be taken in this essay is that these educators have severely limited the meaning of "concept" in their use of the "concept approach" that it is not as educationally fruitful as it might be.

For example, the purpose of the meetings held in July, 1962, by the committee of the Home Economics Division of the American Association of Land Grant Colleges and State Universities is revealed in the committee name, "Articulation of Home Economics between the High School and the College." Logically enough, in solving a problem of articulation between various teaching levels, the first step was the "identification of the key concepts in each of the subject matter segments of the field." (81: 1) In other words, the concept approach was intended primarily to aid communication. This judgment is evidenced by the fact that the committee spent much time in lengthy debates over wording. Although the "concept approach was utilized ... as a means that would allow eventually a critical appraisal of curricula, course content, and learning experience," (81: 1) the concepts that were finally decided upon were derived solely from the subject matter with no apparent attempt to justify the results in terms of their educational value.

Another example of the limited use of the "concept approach" is its use as the basis for the revision of New York State home economics curriculum. The chairman of the New York State Home Economics Curriculum Revision Committee referred to a concept as "an organization of subject matter and materials." The intended purpose of using the concept approach in the new curriculum is to communicate the organization of the content of home economics courses, as well as the content itself, to the teachers throughout the state to help "organize the teachers' thinking." (75) Here, then, concepts serve to aid organization as well as communication.

A much broader use of "concept" than either of these groups made is implied in the definition of "concept" offered by the U. S. Office of Education group which made the first "Suggested Outline of Concepts for Home Economics." "Concepts are abstractions which are used to organize the world of objects and events into a smaller number of categories. These, in turn, can be organized into hierarchies." (76: 7) If this definition is viewed in terms of the student, whose needs and interests should be at the base of any curriculum change, it is possible to make a curriculum of learnings which are meaningful and cumulative for the student. With the present limited use of the "concept approach", any intended benefit to the student from the changes taking place can only be implied.

The gaining of the "abstractions ... used to organize the world of objects and events..." is a process which has attracted the interest of experimental psychologists, as well as a product, the existence of which puzzles philosophers and often eludes teachers. Concepts are means of communicating only because they are primarily outcomes of learning, the internal collection of an individual's past experiences, and are, very simply defined, the means by which an individual manages to think coherently. Organized thinking improves the possibilities for communication and, it follows, for receiving and making sense of what is communicated. A more meaningful use of "concept," operational in the learning process, can be more educationally valuable because it stipulates the means by which the student can benefit from a new curriculum.

The teacher is responsible for both her own concepts, in order to communicate effectively, and for those of her students, for learning to take place. The curriculum groups have thus far been concerned only with concepts as products; experimental psychologists have investigated the process of learning concepts. The teacher profits from both approaches, and the home economics teacher would profit from a curriculum in which the two approaches were unified.

CHAPTER II

THE MEANINGS OF CONCEPT

1. Concepts as Tools in Curriculum Design

"Concept" is a term used meaningfully at present by both educators and researchers. However, several quotes will serve to point out the wide differences in the use of the word:

> Learning new concepts is perhaps the most important kind of learning a child must master. One of the reasons teachers of primary children begin the early reading experiences with trips to the zoo, the store... and the post office is to assure firsthand knowledge essential to an understanding of the concepts they will meet in their reading. (38: 76)

> One approach (to curriculum revision) that merits careful reflection by all educators is to focus upon the identification of the fundamental principles, the broad concepts, the big ideas in the various subject fields...These questions should guide this process: What are the fundamental principles, the central concepts, the major ideas associated with a field of study? Which ideas are central to an understanding of the methods of inquiry unique to that field? Which ideas underlie a whole series of other ideas and are thus essential if any real understanding of that field is to come about? (54: 13)

> (Concept formation is the) process by which an organism develops a symbolic response (usually, but not necessarily linguistic) which is made to the members of a class of stimulus patterns, but not to other stimuli. (55: 277)

> Concepts are cognitive organizing systems which serve to bring pertinent features of past experience to bear upon a present stimulus object. Assuming that a stimulus has some effect upon the person (he perceives it) there are evoked processes whereby the object is interpreted, given meaning, and linked with the other concurrent activities of the organism. (65: 527)

The first two speakers are educators, concerned with the concept as a product of learning. The following two are scientists, involved in the problem of how we form and manipulate concepts; they investigate the process of concept formation. When the scientist first became interested in this process of concept formation, he borrowed the idea of the concept from philosophers and early psychologists who had arrived at it by logical means. They realized that men held meanings which were apart from the things in which the meaning resided. Groups of meanings were somehow connected internally and the "truth" of a concept could be determined by logical analysis, as in the classic syllogism: Socrates is a man; all men are mortal; therefore, Socrates is mortal.

Scientists analyzed this kind of thinking in scientific terms. The syllogism can be thought of as a series of classifications or categorizations, requiring perception, (Socrates has ears, eyes, arms, legs, etc.), abstraction and generalization (Certain of these perceptible characteristics are unique to a class of objects we call men, so Socrates is a man. Man, further, belongs to a class named "mortal", so Socrates belongs to this class, too.) This kind of analysis allowed scientific methods to be applied to a logical construct which seemed to imply an investigable process.

The situation has now come full circle. Mechanical information processers, made possible with the increased understanding of human concept formation, (at least its information processing, or classifying aspect) are depending on symbolic logic for their "blueprints", and are "an important influence in the contemporary analyses of the thinking process". (33: 447, also 31)

To say that we have come full circle is not to say that thinking on the subject is completed. In fact, it is hardly begun, as a review of the literature in concept formation will indicate. To say that we are back at the point where we began is no less false. The many dimensions which have been added to the idea of "concept" can be of great value to the educator in his use of the word.* What is relevant to the evolving fact that the product and the process of concept learning are interdependent, regardless of the point of view from which they are approached, and a question about one (product or process) cannot really be answered without recourse to the other.

This is an important point for curriculum makers if the concept-curriculum is to be a description of the products of student learning. A concept, in order to "work" in a curriculum, should be the logical outcome of a process of education designed for concept learning.

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* The dimension, "simple to complex", describing the extremes in what is termed a hierarchy of concepts and intended to emphasize the cumulative nature of concepts, is demonstrated in the opening quotations of this section. (38) and (55) refer to more simple concepts than (54) and (65), which refer to more complex concept systems.

2. Concepts and Learning

Concept learning is the most desirable type of learning from the student's point of view. For those of normal or above intelligence, a thoroughly conditioned change of behavior is not considered the most advantageous kind of learning in our society. Neither is the learning of arbitrary associations, as for example, the memorization of the meaning of a vocabulary word without experiences with the word which give it real meaning and applicability.

Instead, education aims at giving meaning--the meaning of a book, a science experiment, an historical event, or a method of food preparation. According to Herbert J. Klausmeier, "A concept is the meaning or meanings that the individual associates with words, other signs, and direct sensory experiences, and the meanings are based upon discriminations and associations." (35: 155) A concept, by definition, is the means of assuring transfer to other similar situations. Because the concept and the process of attaining it are interdependent (A concept is not a concept unless it has been conceptualized), concept learning can be employed as a means of learning to learn. For example, in concept learning experiments, students who were instructed in the nature of a concept and of their task learned more efficiently than control groups who did not receive instruction. (43) In experiments which ostensibly dealt with memorization, subjects who discovered a concept within a group of experimental stimuli learned more efficiently and retained information better than those who attempted to continue memorizing. (30)

Educators have confused the terms "concept", "principles", and "generalization". The barrier presented by the lack of a clear distinction among these terms can be overcome by considering concepts as existing in a hierarchical fashion. "Dogs" and "cats" are "animals" which are "mammals". In this simple example are concepts which exist at different levels. It seems that principles and/or generalizations can be thought of as the links implied between the levels. Whitehead has said of the essence of the concept and the principles and generalizations it includes: "Your learning is useless to you till you have lost your textbooks, burnt your lecture notes and forgotten the minutiae which you learned by heart for the examination,... (until you shed details in favor of principles." (72: 37)

Concept learning, then, can be distinguished from the learning of facts and of skills which are learned by repetition, without variation, of the same phase or movement. If, however, a series of facts takes on meaning for the learner because of some relationship among them, or, if a skill is learned in such a way that the learner can assess different situations and vary his behavior accordingly and can discover relationships between methods and outcomes, then conceptual learning is probably involved.

The determining factor is the meaningfulness for the student. However, conceptualization is more than "understanding". As Whitehead implied, a concept is tested by using it in some way. Concepts are aids to learning as well as valuable outcomes because of their tendency to accumulate in an organized manner and the resulting possibilities of increased meaningfulness for the student.

We return to the original question of this section, "What is the nature of a concept that makes it a productive approach to improving curriculum?" and answer it further by means of a definition in which the attempt is made to relate process and product of concept formation for the educator.

3. A Definition of Concept

The educator's main reason for referring to learning as a change in behavior is that this approach makes measurement of learning possible. What is really desirable is that meaning should be attached to this change of behavior. The trouble with this qualification, however, has been that it turns the problem into a philosophical as well as a psychological issue. Plato was concerned with the distinction between shadow and reality,between thinking and the object of thought. The role of the concept in answering this question is indicated by Vinacke, in The Psychology of Thinking: "In our view, concept formation involves processes of perception and learning by means of which the individual develops an organized and coherent relation to the external world." (65: 98)

Gaston Viaud (64) has written that "a concept is a condensation of experience ... a concept is a generalized and abstract symbol; it is the sum of all our knowledge of a particular class of objects." Coupled with his explanation that "concepts are systems of knowledge that are constantly within the reach of our thought...and enable us to summon this knowledge into consciousness whenever it is needed," (64: 75-77) Viaud has accomplished a remarkably complete, though abridged, definition of "concept". Should his definition seem too simple, bear in mind throughout this essay Vinacke's statement of the magnitude of the idea of "concept" and the part it plays in learning:

> One of the most difficult aspects of thinking is that which concerns concepts. One reason is that the formation and use of concepts bears important relationships to many of the psychological problems, notably the nature and development of language, the development and functions of perceptions, and the phenomena of social interaction. A second reason is that concepts appear to involve complex, 'higher' mental processes, which are more difficult to understand and investigate experimentally than other behavior. In speaking about concepts we appear to be dealing with phenomena almost without parallel in the scale of life, processes so complex and so closely associated with nervous activities inside the organism that most of our conclusions require the extensive use of inference. (66: 98)

Much of what is known about concepts has, as we shall see, been inferred from behavior, either in the experimental situation or in everyday life. Viaud's definition summarized the role of the concept in experience; it is well worth examining and expanding part by part.

"...a concept is a condensation of experience..."

Man is unable to store all the information which comes to him in each experience he meets. Although when facing a forest a man is capable of discriminating between a maple and an oak, between one leaf and another, between the maple on the right and another to the left, when asked what he saw, he would probably reply with the general term, "forest". Coming upon another field of trees, this time evergreens, the same man, or any other, will probably respond "forest" again when asked what was there. The man does not store all of his perceptions separately, but instead retains the concept "forest". (The exception to this would be the man who was, for his own purposes, particularly interested in specific types of trees.) Whitehead used this same metaphor and made the point that, "The problem of education is to make the pupil see the wood by means of the trees." (72: 18)

Bruner, in a *Study of Thinking* (5) pointed out the ability of man to discriminate a vast number of differences in the objects and events which confront him and his inability to deal with the vast complexity resulting, and called it a "seeming paradox". (5: 1) The resolution of this seeming paradox he attributed to man's conceptual ability, man's "capacity to categorize". (5: 1) His example is that of the range of color, along which there are estimated to be more than seven million discriminable colors, yet men find that about a dozen names usually suffice. Bruner went on:

> To categorize is to render discriminably different things equivalent, to group the objects and events and people around us into classes, and to respond to them in terms of their class membership rather than their uniqueness. Our refined discriminative ability is reserved only for those segments of the environment with which we are specially concerned...By categorizing as equivalent discriminable different events the organism *reduces the complexity of its environment* (author's emphasis). (5: 1)

Bruner's definition of concept formation as "categorization" is not as limited as it might seem. We categorize, it seems, when we decide whether a law applies in a certain case or whether one procedure or another is better for a particular problem. The judgments we make in terms of our goals and values are certainly categorizations; we cannot judge unless we perceive the aspects of a situation which are relevant to our purpose and have a concept with definite limits which either includes or does not include the case being decided. Once a decision is made, this experience further increases the meaningfulness of the concept.

Vinacke also viewed concepts as the means of organizing our accumulated experiences. (66: 105) Concepts are "systems within the mental organization which link discrete sensory experiences. This condition may be demonstrated by proving that an individual responds to different stimuli in the same way." (66: 101) The ties or links to which Vinacke referred are obscure and uncertain. However, the idea that condensed experiences are somehow linked in an internal organization is demonstrable. According to Vinacke, words are those symbolic links in a system of organized experience. "A word ties together different experiences with the same object, experiences with objects somehow related to each other, the emotional processes aroused in these experiences, etc. Men do not store all of this; these experiences are condensed into a word." (66: 101)

Robert Thomsen, a British psychologist, expressed the same idea about the necessity of condensing experience.

> If we did not categorize or classify automatically, we would be faced with the exhausting and complicated task of relating every particular item in our experience to every other item in the context of their occurrence. We would flounder in the immediate concrete situation and be unable to interpret it. (62: 65)

The resigned advice, "Oh well, live and learn," is actually about concept learning, since our concepts are the means by which we profit from experience. Instead of learning each of our experiences, we learn from them. We condense from an experience that which has meaning for us in terms of other, similar experiences. We add to our concept of a thing as our experiences demand. A concept is not derived from one experience, but from many. The extent to which we can perceive in a situation that which affects our concept in one way or another, organize this information into our existing concept and use the concept in a further situation, is really the way we "live and learn." If experience is for a person only an agglomeration of unassociated facts, or results only in a set of more or less conditioned skills and other responses, then "live and learn" becomes a warning. Meanings must be transferrable; we must be able to make general statements or rules about things so we can react reasonably among similar things.

"...a concept is a generalized and abstract symbol..."

Informational footnote: Psychologists who have conducted experiments in concept formation not requiring the use of verbal symbols would argue this point, but it is safe to say that most concepts are usually symbolized verbally.

Viaud here gives us the processes of categorization which have been inferred from conceptual behavior, the means by which an individual condenses experience.

Vinacke stated that "concepts are not direct sensory data, but something resulting from the elaboration, combination, etc., thereof... a verbal response is merely a label for the cognitive system, which, from the psychological standpoint, is actually the concept." (66: 100) In other words, the concept is not the object, or event, or other phenomenon that is perceived, but the mental construct that remains. In Viaud's terms, the concept is what the individual "condenses."

Vinacke's distinction between the two processes which have been considered to comprise concept formation is helpful:

> Abstraction signifies the linking of one sensory experience to another, during which some details are left out and others become dominant...Generalization signifies that the dominant details resulting from abstraction are used as a basis for responding similarly to the separate objects linked by abstraction, and for responding to other objects similarly linked. (66: 104)

Abstraction from experience, then, implies that the common features of relationships among a group of experiences are the basis of the concept; generalization requires that an individual have either a previous concept or a hypothesis about a set of experiences with which he then tests each instance to see if it fits.

The difference between these two approaches is well put by Bertrand Russell and Alfred North Whitehead in their attack on each other's method of making sense of this world. Russell, Whitehead said, was "simpleminded." Russell considered Whitehead "muddleheaded." Russell approached a complex problem by breaking it down into smaller parts which he could then solve correctly without doubt. Whitehead felt that one was not facing up to a situation unless he considered it as a whole. (84)

These two approaches to the organization of experience are not thought by psychologists to be mutually exclusive, especially in those past childhood, who seldom form completely new concepts, but learn to apply or modify a concept already held. (66: 104)

Bruner made a distinction between the perceptual and conceptual modes of categorization; these seem to be partially equivalent to the processes of abstraction and generalization. "Categorizing at the perceptual level consists of the process of identification, literally an act of placing a stimulus by virtue of its defining attributes into a certain class....Categorization of conceptual objects also (in addition to perceiving the attributes) involves the fit of a set of objects or instances to the specifications of a category." (5: 9)

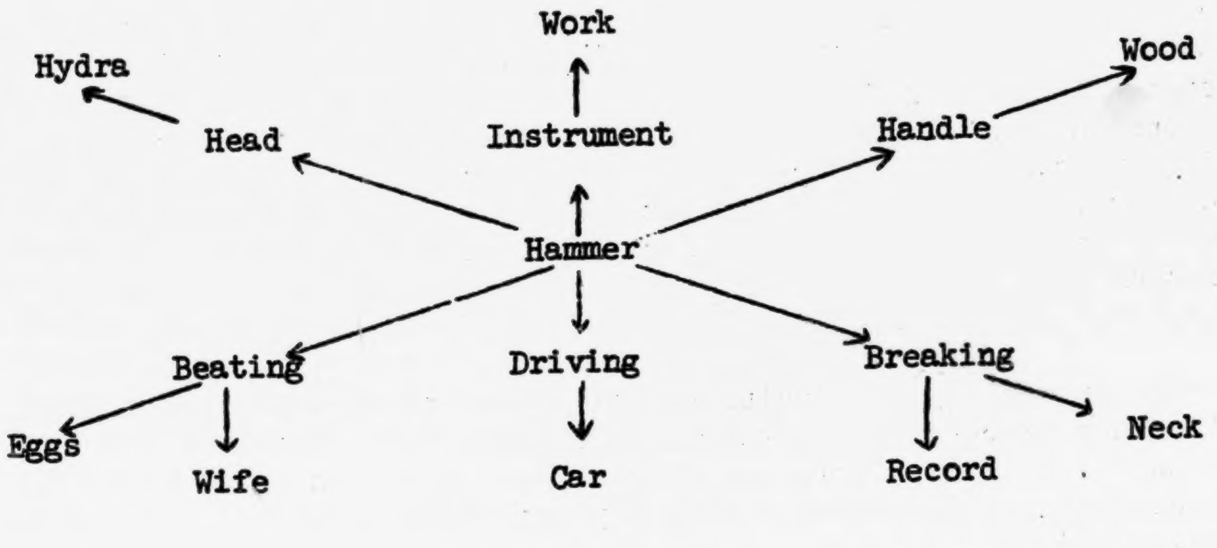
Bruner said that the underlying process is the same, that these two extremes are at opposite ends of a continuum and that the major difference is the "attribute immediacy" (5: 10) or the ease with which a need to categorize can be met perceptually. Experiments have shown that some people prefer to proceed as far as possible using only perceptual categories; others take a more active part in the process and begin early in the experiment to set up tentative rules in hopes of speeding up the acquisition of the concept. Bruner has done much work on the "strategies" of concept attainment (which will be discussed later) in which he discussed the increased "mental strain" of the conceptual mode of thought over the perceptual. It is somehow "easier" to discover the common visual properties, for example, of a group of objects than to discover common relationships expressed verbally.

> "...it is the sum of all our knowledge of a particular class of objects."

In addition to facilitating a unified approach to the process and products of education, the concept helps educators in an analysis of the dimensions along which meaningful knowledge can exist.

Viaud's use of the word "object" is unfortunate. In the author's opinion, "objects" might better read "facts". "Facts" should then be interpreted as any objective information received through the sensory organs--an event, a person, a machine, a book, etc. In other words, an individual's concepts form and develop out of his own experience. An explanation of the dimensions in which concepts seem to develop follows:

Viaud's examples included that of the concept, "dog"; it is "the sum total of the properties that distinguish the dog from all other animals." (64: 75) He also visualized concepts as crystallizing out in a network:



Gaston Viaud, *Intelligence, its Evolutional Forms* (New York: Harper and Brothers, 1960), p. 76

This dimension of a concept, which might be labeled "denotative, connotative," is of great importance. In the first case, that of the "dog", the concept is considered to be a relatively precise number of qualities which serve to allow classification of an object as "dog" or "not-dog". The concept of dog is readily shared by others, it is communicable, and can be taught. Hunt said that the very thing which distinguishes a concept such as "dog" from the fact of any one dog one perceives is that the concept can be communicated to another person without resource to live dogs or pictures of dogs, that is, without examples; (31: 7) in other words, it can be taught by means of symbols. (To be learned, however, it is necessary that the concept be embodied in experiences.) The concept, "dog", is concrete and it refers to a perceivable set of objects. It is easily validated, or confirmed, by asking someone, or going to a book. It is a class concept and its members either belong or they do not belong. Its defining attributes are the sum of what one has learned is peculiar to dogs. Hayakawa called this an "extensional" concept, that part of the concept system corresponding to the objective properties of the stimulus object, "that which the words stand for." (66: 101)

The second example given by Viaud is one of the "intensional concepts," so-called by Hayakawa. He defined these as "that which is suggested inside one's head." (66: 101) Vinacke said, "the intensional aspect corresponds to that part of the system which derives from the individual's unique experiences with the stimulus object and the ramifying relationships which the concept system has with other systems." (66: 101)

This aspect of a concept is unique to an individual and is probably not entirely communicable. The meanings or parts of the concept which are aroused will vary with the particular situation. Use of this type of concept cannot be validated in its entirety and an individual can have a wrong, or eccentric, or antisocial concept which experience may give no cause to change because experience is perceived in the framework of the individual's concepts and condensed into this framework or the individual's conceptual organization. Misconceptions which "color" experience are especially prevalent in the connotations of the symbols of our concepts. Teachers can more easily build, check, and correct the denotative aspects of concepts than they can insure an appropriate range of connotative meaning. However, teachers need to be aware that both types of concepts are in operation with every experience and both are a basis for building concepts in future experience.

The increasing meaningfulness of a concept as experiences with it increase proceeds in another set of dimensions, vertical and horizontal. (67, 68) Vertical concepts are those in which groupings are increasingly inclusive. Such a progression would be: dog, animal, mammal. (64)

A horizontal organization of classifications might be: collie, beagle, terrier; these are mutually exclusive categories. Another example of horizontal organization of concepts is one in which one's concept of "dog" expands to include such additional meanings as: she's a dog, dog days, hot-dog, etc., categories which are also mutually exclusive. Concept formation in the vertical dimension usually involves perception of relationships, which allow experiences to be classified in hierarchies and approximately corresponds to "depth" in learning. Hempel (22) referred to the vertical dimension as "real" conceptualization, which is characterized by explication of relationships and essential values. (22) The accumulation of concepts at increasingly abstract levels would be development in the vertical dimension.

Broadening of a concept in the horizontal plane would mean somehow changing the limits of a category in the direction of greater breadth or completeness of concepts, or increased accuracy or clarity of a concept. It can also mean developing new groupings for experiences on the basis of new needs. Hempel described this as the "nominal" concept, a "logical definition", the "logical product of two classes or properties". (23) Development of a concept in the horizontal dimension might involve learning new names or applications of known names. Various authors speak of concepts as becoming more exact, or more abstract, or more clear, or more flexible. Clearly, the appropriate development of a concept depends upon the nature of the concept.

Brownell viewed learning as a process of reorganization of concepts. "Responses made at the beginning...are crude, clumsy, uneconomical, inexpert, inexact, undifferentiated, and lacking in meaning. The responses made at the end...are refined, neat, expert, economical, precise, and full of meaning. Learning proceeds stepwise, from level to level." (3: 109) These conditions may be descriptive of experimental behavior, and of much of the conceptual behavior of real life, but it is not always desirable that a concept become more economical and precise. Brownell himself noted "the adequacy of the concept is to be judged in light of the needs and purposes of the learner at the time." (3: 109) A lack of precision and economy of classification is essential in the correct use of some concepts. "Democracy" and "right" are concepts which we may view either as imprecise and flexible, or as continually changing.

The former is probably the case. We realize that democracy is a concept which is highly abstract, derived from sometimes conflicting experiences, and rich in intentional meaning. Therefore, the "correct" concept of democracy is one which allows us to classify a country as a "democracy" or "non-democracy". The correctness of the concept is largely a matter of the degree of ambiguity of meaning which is tolerated by the individual. This is an important point in a discussion of concept learning.

A concept must be in character with the "facts" of experiences which are conceptualized. Not all human experience is condensed into precise rules of classification. It is not desirable that each of the concepts an individual holds be "complete and accurate," (5: 29) as some psychologists seem to imply. Teachers should have as a goal the students' attainment of concepts that are no more concrete or abstract than the nature of the concept and the needs and purposes of the students indicate. For example, a concept of "family responsibility" should not be reduced to a list of rules for family members. That would be out of character with the more ambiguous nature of the concept and the students' need and ability to grasp a more abstract and less clearly defined concept. A concept, on the other hand, such as "Vitamin A" can be more concrete and precise; but not more so than the students' needs require. For example, learning its chemical formula would be irrelevant for the purposes of most high school students.

Concepts also range along a continuum of meaningfulness. Meaningfulness increases only with increased experiences with a concept. Several studies reported by Vinacke showed that variation in experience caused as much difference in the level of concept attainment as either chronological or mental age. (66: 119)

Authors emphasize that teachers should provide an abundance of varied experiences in teaching for concept learning. At the lowest level of concept formation, it is difficult to know whether a student is gaining a concept or an arbitrary association. (3: 114) Experience with the concept in varied, rather than repetitive, situations with varied materials will promote concept learning.

Concepts, it should be realized, are formed from all of an individual's experiences, not just those the school provides. In home economics, this fact is of prime importance. There is no such problem in world history, for example, of the "tremendous gap between the pupil and the materials with which he works," where an obstacle to learning is "the difficulty the pupil encounters in developing accurate concepts of time and space." (14: 107) The problem in home economics is not one of lack of experience with the concepts used in the subject matter, but instead, of a backlog of some experiences which vary for each student, thus resulting in a range of concepts which a teacher finds difficult to assess, especially in their intentional aspects. An inconsistent concept revealed in the comment, "In our family, we don't like vegetables, and that's reason enough for not eating them," or an incomplete concept, for example, "I already know enough about that" is a greater barrier to further learning than the previous case where little, if any, concept existed previously because the subject matter was not within the experience of the pupil. Incomplete concepts may be a greater barrier to learning because first of all, an individual uses his concepts, once formed, as the basis for categorizing future experience and tends to resist changes or shifts in the concept.

Secondly, a pupil can hold and use a concept without the verbalization that might reveal incompleteness or inaccuracies. Classroom experiences are then made meaningful to the student in terms of his own inconsistent concepts.

And last, an individual may tend to resist consciously organizing his concepts in a hierarchical fashion beyond a certain degree. This is an observable point. Experiments have shown that more "mental strain" is required to learn a hierarchical concept of two objects and a class name than to learn names for three objects. (67) In another type of experiment, increasing the complexity of the material from which the concept was to be formed led to the formation of concepts with double and triple meanings for many subjects rather than the educative search for a consistent concept. (45)

"Concept", therefore, is used by educators primarily to describe a product of learning and by scientists primarily to describe a process of learning. Concepts are the most efficient and useful way humans have of processing and storing the information received in experience through all the senses; thus, concepts are a desirable outcome of education. "A concept is a condensation of experience... a generalized or abstract symbol...the sum of all our knowledge of a particular class of objects." (64: 75-77) Concepts are described as existing in several dimensions: denotative, connotative; vertical, horizontal; incomplete, complete; no meaning, meaningful.

The value of the concept approach to curriculum is that, if used in a fuller sense than is presently the case, both process and product can be examined in the same frame of reference, making possible a unified approach to the means and ends of education. Since process and product are interdependent, it is possible to design a curriculum to promote concept learning in the student as well as to communicate the organization of the subject matter to the teacher.

CHAPTER III

EXPERIMENTS IN CONCEPT FORMATION

Among the many things Bertrand Russell said about education, the following, slightly paraphrased, is relevant in attempting to define a concept. "The important thing is not to know how to spell words, but how to use them." (50: 22) It is not as important (and it is inappropriate) to define "concept" precisely as it is to use it fruitfully, for a word becomes meaningful only in its use, or, in other words, when a person has formed a useful concept of it. The discussion in the previous chapter of the meaning of concept was intended only to set limits within which the word could be used. These limits are, at one end, concerned with the formation of a concept as a psychological phenomena in a human (or lower) organism, and at the other, as an organization of meanings held by an individual or inherent in a recognized field of human endeavor. The value of the concept approach is that both process and product can be examined in the same frame of reference; this makes possible a unified approach to means and ends. When its use is limited to communicating the organization of a subject matter among teachers, the value is lost, and the approach might as well be labeled the "topic" approach.

If the basic concepts of the subject matter are to be acquired by the student, and the process is a psychological one, then we can turn to the experimental psychologists who have investigated the process of concept formation and the conditions which affect concept learning.

1. Concept Formation in the Experiment and in the Classroom

If we are to infer anything about classroom learning from experiments in concept formation, it will be necessary to examine the relation between concept formation in the experiment and in the classroom.

For this purpose, it will be profitable to describe the methods of several of the common types of concept formation experiments. In a recent book, Hunt (31) compared the human subject in a concept learning experiment with a modern digital computer. In the ideally efficient situation, the subject receives data, hypothesizes a classification rule and uses it to classify the perceptual data of the experiment.

The information received when the classification is either confirmed or corrected is stored by the subject and accumulated until the classification rule is precise (or useful), and can be used and transmitted without recourse to the examples; a classification rule which organizes a situation has been abstracted from it and exists independently of the instances from which it has been derived. Further information can be "processed" according to this rule.

The early experiments in concept learning are interesting because they were made to appear to the subjects as exercises in memorization; concept learning has of course, valuable use in education because of its difference from rote learning. One of the earliest experiments in concept learning required that the subject make the switch from memorizing perceptions to conceptualizing without being directed to do so, and perhaps without realizing it. Hull's experiments were the beginning of the objective, quantitative approach to concept learning that has culminated in the ability to reproduce the behavior in a machine. Hull (30) used series of Chinese characters in which each series had a simple character as the basis of increasingly complex configurations. This common characteristic was the determinant of the common name, a nonsense syllable. Determining whether the subject had the rule was accomplished by asking him to draw the common element of the characters. The process required perception of the characters, a consciousness of the possibility of organizing these perceptions arising from the discrimination of common characteristics, a series of experiences in which only the relevant characteristic remained constant throughout, and the development and application of a rule for the name. Hull used a device that is common in both memory and concept learning experiments, a memory drum. Each experience with the concept is perceived separately for a given period of time. The information to be gained from each exposure to the material embodying the concept must be retained. After several instances, it becomes necessary to organize this information in some way in order to remember it. According to Hull, this was the beginning stage of forming the concept. (30)

Hull's experimental task was largely a perceptual problem involving the isolation of one attribute. Smoke (56) developed a task in which the subjects were to discover relationships common to the instances that were presented as positive examples of the concept. After being shown both positive and negative examples, the subject was instructed to make a guess about the classification rule as soon as he thought he had learned the concept. The experiment proceeded in the following way:

> Experimenter: "I shall give you three tests. The first of these is that of definition. Please state what a '_____' is". After the subject had finished, the experimenter gave him another sheet of paper, saying, "The second test is a matter of drawing. Please draw two '______'s." In...the third test the experimenter...said, "Here is a series of sixteen drawings. Some of these drawings are '_____s' and some of them are not. If the drawing is a '____' write 'Yes' after its number. If it is not a '____' write 'No'. If you should happen to change your mind about what a '_____' is, be sure to stop and change your definition." (56: 137)

Later experiments used such techniques as the Vigotsky block sorting procedure. The materials consist of wooden blocks of different colors, shapes, heights, and sizes, which are to be categorized into four groups.

> At the beginning of the experiment all blocks, well mixed as to color and size, are scattered over the central circular part of a square board, the rest of which is divided into four different kinds of spaces...The subject is told that there are four different kinds of blocks, that each kind has a name and that his task is to find the four kinds, and to put each of them into a separate corner. The examiner then turns up one of the blocks, shows its name to the subject, and putting it into one of the corner spaces, suggests that the subject start by picking out and putting in the same corner all blocks which he thinks might belong to the same kind. After he has done so...the experimenter turns up one of the wrongly selected blocks, showing that this is a block of a different kind, and encourages the subject to continue trying. This he may do in any way he pleases...and the process continues until the subject discovers the principle of classification, and... the subject is asked to formulate the principles of classification. After this the blocks are turned over once more, this time without any help from the examiner. (19)

Similar in aim and procedure is the commonly used method of card sorting. In this method, each response of the subject is validated or corrected, so that new hypotheses of the classification principle can be formed and tested in succeeding tries. This method makes it possible to analyze the steps followed in forming a concept. The task is well explained to the subject in an experiment by Sechrist and Wallace:

> In the following problem, I will begin by showing you a card which will be a positive example of the concept that I have in mind. After I show you the card you will be asked to select more cards from the board in front of you. After each one of your selections I will tell you whether the card you have chosen is positive or negative. If it is positive, you know that both of the attributes that define the concept are present on the card. If it is negative, you know that both of the attributes that define the concept are not present on the card. You may take as many cards as you wish, and you may offer one suggestion as to what you think the concept is that I have in mind after each one of your selections. Your task is to figure out what the concept is that I have in mind using as few of the cards as possible. Try to avoid guessing and make a real attempt to use information you get from the cards in a logical manner. There are no tricks. Do you have any questions? If not, let's begin. Here is the first card and it is a positive instance of the concept which I have in mind. (52: 159)

Certain differences between the concept learning of these experiences and that of the classroom are at once obvious. In the experiments described above, the concept to be formed is not a real-life concept. The reason that the so-called "closed" concept is often employed in experiments is that only by guaranteeing that a new concept is being introduced to the subject can the process of concept formation be observed. This guarantee is made possible by devising a classification rule which is not useful outside of the experimental situation. However, not all concept learning experiments deal only with nonsense syllables, geometric shapes and the like; for purposes other than the study of concept formation, familiar concepts and/or materials are sometimes used.

Another difference is the degree of certainty about the defining attribute of the concept and a regularity of procedure in the experiment that is not found in the classroom. The tasks in the experiments have been simplified to approximate the basic processes of concept formation. Data received in real life, in contrast, is multitudinous and the system of concepts into which it is organized is infinitely complex. The classroom has been referred to as a simplified environment, but the concept formation taking place there is far more complicated and more spontaneous than in the concept learning experiment.

However, the relation between concept formation in the experiment and in the classroom is the same. Reference to the dimensions of "concept" discussed previously will clarify this point. Concepts exist on a number of continuums in several dimensions, but the process of conceptual thinking, perception, abstraction and generalization, are the processes of forming concepts at all levels. The examples given in detail above require perception, abstraction, and generalization, the processes of concept formation. Common to all is the fact that the subject gradually evolves the concept from his experiences in a series of situations which provide information about the concept.

Formation of the concept depends upon the information that is gained from each instance and the use that is made of it.

In the classroom, too, it is necessary for the student to gradually build concepts by gaining all possible information from a situation and choose from it what is relevant for his purposes. The teacher's job is comparable to the experimenter's: to establish the concepts to be learned, to provide a series of experiences in which the students can perceive the concept, and to ascertain the extent to which the concept is already held by the student in order to correct or validate those aspects of it which have been gained outside of the school situation. The teacher must be sure that the concept has been communicated to the student in the materials and experiences provided and that the student attains a concept which is consistent and useful.

Several other factors affect the extent to which information yielded in concept learning experiments can be applied in the classroom situation.

Students in experimental studies of concept formation are usually college students, advanced, as a group, in age and intelligence beyond the high school students concerned here. The age variable in conceptual ability will be discussed at a later point in this paper, but maturity is an important factor in the level of concept formation which can be achieved. However, the process basic to concept formation is evident in concept formation at all stages of development, and it follows that the same factors will affect efficiency of concept development at all stages.

Several methodological criticisms can be made of concept learning experiments in general. Subjects are usually either volunteers, or students enrolled in education or psychology classes. Several experimenters have reported occasional difficulty in getting a subject to take the experiment seriously. The non-random nature of the subjects has unpredictable effects, if any, on the information gained. Replication of the experiments has increased the reliability of the findings in many cases.

Experimenters have not used the same measure for the dependent variable, concept learning. Some experimenters speak of rate of learning, some of number of corrections needed, some of efficiency of using information, and still others measure rate of retention and ability to use the concept.

Despite these limitations of concept learning experiments, certain information about the process of concept formation and the factors affecting it has resulted from these experiments and appears to be applicable in the classroom.

2. Factors Affecting Concept Formation

Herbert Klausmeier, in one of a series of experiments in concept learning reported to the American Educational Research Association in Chicago in February, 1963, classified the variables affecting the efficiency of concept learning which have thus far been experimentally investigated as those of "task" variables, "methodological" variables, "organismic" variables, and "strategies." (80: 18)

Task variables relate to the characteristics inherent in the concept learning task of the experiment. Methodological variables include differences in the communication of the concept to the subject. Organismic variables are those pertaining to the intellectual, psychomotor, and affective conditions of the subjects. Variations in strategy arise from the fact that the same subject in different situations or different subjects in the same situation will approach the concept learning task in distinctly different ways. The choice of a "strategy," however, is not always entirely up to the subject. Organismic variables may determine the subject's affinity for one or another strategies; the nature of the task or methodology may also determine the course the individual will follow.

These experimental variables, translated into different terminology, are the variables with which the teacher must deal: the characteristics of the task, teaching methods, characteristics of the learners, and, very loosely translated, learner's study skills. Therefore, a review of the research in concept formation organized with regard to these variables should be helpful in the attempt to apply experimental findings in the classroom situation.

Task variables

Task variables include the type of concept to be studied and the nature of the materials used in the experiment.

Bruner (5) classified the types of concepts in reference not to the dimensions along which concepts seem to exist, but to the criterion of their categorizing rules. The terms he used are "conjunctive," "relational," and "disjunctive." The conjunctive concept has a classification rule which says that when the appropriate number of attributes occur together in a stimulus, it is an instance of the concept. Most concept formation experiments deal with this type of concept (for example, rules such as, all words which are animals, or all objects which are round and green). A relational concept is one defined by the presence of a number of attributes in a certain relation to each other (Bruner's examples included that of all cards having a fewer number of figures than borders). (5: 41) Smoke (56), Stacey and Cantor, (57), and Shore and Sechrist, (53) have used this type of concept in their studies. Stacey and Cantor (57) used Zazlow's test of the attainment of a concept of a continuum, and found it more difficult than the commonly used block sorting test in which the concept was conjunctive. In both conjunctive and relational concepts, subjects can assume that attributes of the concept apply consistently and that just as the perception of a defining attribute always means an instance of the concept, an instance announced to be an instance of the concept will always contain all of the defining attributes.

In real life, we do not, of course, deal with certainties such as are made possible in an experimental situation; instead we base our categorizations on probabilities. Experience gives a guide to the odds we gamble on that our concepts are accurate. The lack of absolute certainty does not obscure the logical relationship of attributes and concepts in conjunctive and relational concepts.

The third type of concept posited by Bruner is the disjunctive concept, in which any one or a combination of attributes defines the concept. Bruner's examples of this type of concept included a baseball strike, which is "a pitch that is across the plate and between the batter's knees and shoulders, or it is any pitch at which the batter strikes but fails to send the ball into the field." (5: 43) When Bruner attempted to introduce a disjunctive concept to his subjects, 70 per cent of them failed to attain it, although instructed in the nature of a disjunctive concept. (5: 178) This he attributed to the subject's assumption that they could use the same strategies that were profitable in attaining a conjunctive concept and to an attitude of Western thinking that "common events have common causes." (5: 181) Disjunctive concepts are not consistent with Aristotelian logic; they are purely arbitrary. Bruner's observation was that we try to find the common elements in disjunctive classes, rather than be left with a disjunctive concept we are uncomfortable using. We find it clumsy to use a category where "two of the members, each uniform in terms of an ultimate criterion (the concept) may have no defining attributes in common." (5: 156)

At the basis of any conceptual behavior, there must always be some kind of perceptual activity. To condense experience into categories, a person must perceive the elements of his experience relevant to the categories. The availability to perception of the relevant characteristics of an experience is one determinant of the difficulty of gaining the concept. Disregarding at this point the perceptual abilities of the subject, it is the experimental materials which determine the ease with which the common characteristics or inherent relationships of the instances can be perceived by the subject. In fact, it is upon these materials from which the concept is to be discovered that the adequacy and validity of the experiment largely depends. In assessing many of the studies in concept formation, it is often impossible to determine which results can be generalized beyond the particular set of experimental materials that has been used until the experiment has been replicated or varied in some way in further experimentation. It is an important fact in itself, however, that formation of a concept is a function of the materials and experiences with which the subject is confronted.

A number of experiments have explored the effect of perceptual availability of the concept in the experimental materials. One variation of Hull's experiments evolving a concept from series of

Chinese characters was the drawing of the subjects' attention to the common element by coloring it in red ink in each of the increasingly complex characters of which it was a part. This procedure increased the subjects' discovery of the concept. Hull also found that, using the all black figures, the simpler configurations were more efficient for the discovery of the concept than the more complex ones. (30)

Shore and Sechrist (53), in a task in which the subjects were to discover the common elements of nonsense syllables, supported Hull's finding in the earlier experiment that a lesser amount of time spent observing a large number of instances led to concept formation more efficiently than a greater amount of time spent studying fewer cases. However, they showed that a concept with less perceptually obvious characteristics required a repetition of a fewer number of instances while with relatively obvious characteristics a concept could be attained with single examinations of a larger number of instances. A "perceptually obvious" characteristic in the Shore and Sechrist study was one in which it was easy for the subject to see what the letters in the syllables had in common. The difficult concept required the subject to reconstruct the syllables before they could discover the common characteristics.

Heidbreder conducted a series of experiments in which subjects consistently attained concepts in the order: concrete objects, spatial forms, numbers (20, 21, 22, 23, 24, 25). Heidbreder's explanation was that the more thing-like the concept, the more easily subjects could attain it. She stressed that the difficulty of a concept was inherent in the things being conceptualized. In a later experiment, she compared the use of pictured representations of the concrete objects, spatial forms, and numbers with verbal representations. Her subjects performed better using the pictured material, when the materials "permitted conceptualization at a more perceptual rather than a more intellectual level." (21: 329) (The use of the word "intellectual" is of questionable validity in referring to conceptualization from word symbols as opposed to picture symbols.) In another experiment, Heidbreder tried eliminating the role of memory by using a card-sorting procedure instead of the modified memory technique used in the early experiments. The order of concept attainment found in the previous experiments was not maintained, but varied with the varying dominant aspects of the several sets of cards used. Heidbreder concluded that the order depended upon the directly perceptible "situational support" for one concept or another. (24) In still another variation of her experiments, Heidbreder attempted to eliminate direct perceptual situational support by expressing the instances of the concepts in word symbols. In this case, the determinant of ease of concept formation was the "semantic efficiency of the words." (25: 308) Heidbreder's reasoning here seems to be that if the subjects were not able to form the concept, the words were not good symbols for the concept. This is somewhat circular thinking, but this experiment, as well as the others, has underlined the importance in concept formation of the materials by which the concept is communicated.

Wenzel and Flurry (70), repeated Heidbreder's early experiments with much the same materials; in addition, they instructed the subjects in the nature of a concept and urged them to find a concept rather than to memorize. They discovered the same order of concept attainment.

Dattman and Israel (11), tested Heidbreder's amended hypothesis that within a certain range of situational support for concepts, the order of difficulty of conceptualization is correlated with thing-character of the concept. They criticized her experimental materials, saying that the instances of spatial forms and numbers were not straightforward examples of the concepts, as the instances of concrete objects were. They attempted to devise a set of materials in which each instance was a direct example of the concept. As a result of the attempts to equalize the perceptual availability of the relevant characteristics of the instances, the order of achieving concepts that Heidbreder had found disappeared. The difficulty of achieving a concept can be manipulated by changing the effectiveness with which the materials communicate the concept.

An experiment conducted by Gropper (78), undertook to test the efficiency of teaching Archimedes' principle to eighth graders by means of visual compared to verbal lessons. The visual lessons were telecast. They consisted of "sequences and repetetive demonstrations which required students to make discriminations about the occurrences they saw and on the basis of these discriminations to acquire the ability to predict future occurrences." (78: 2) The verbal lesson contained the same material as the visual lesson and required the same active response on the part of the students. The verbal lesson employed some visual illustrations and the visual lesson included some verbal directions. This may account to some extent for the results of the study, which showed that the visual lesson was as effective as the verbal lesson. Thus, the purpose of the study, "to demonstrate how concepts might be taught by means of visual discrimination training," (78: 11) was accomplished. Students eventually used both types of presentation and further gain in scores was made; those who saw the visual lesson first made significantly greater gains than those who received the programs in the alternate order.

Runquist (49), had different results in his comparison of the effectiveness of visual versus verbal material. He used a list of concepts developed by Underwood and Richardson (63), which consisted of groups of nouns consistently categorized by the same noun or adjective. Runquist chose those concepts with nouns which could be easily illustrated and used three conditions of presentation, verbal, picture-dominant (in which characteristics defining the concept was emphasized in the drawing), and picture non-dominant (in which the defining characteristic was de-emphasized). Runquist used high school students and found that the verbal materials promoted better performance than the pictorial representations. Of the pictorial material, that in which the concept was dominant was most effective. He suggested that these results were affected by the nature of the concepts chosen. Most were not visual concepts and thus did not profit from visual presentation (for example, "soft", a tactual concept).

Tagatz (85), compared the attainment of concepts using verbal and "figural" material. The subject was confronted with a board which held cards containing a number of attributes, some of which were relevant to the concept to be attained. The figural material on the cards included one or two figures of red or green with a broken or solid border. The verbal material consisted of the words used above to describe the figural material. In this experiment, Tagatz found that subjects could conceptualize the figural material more quickly than the verbal material. This experiment was limited in importance by the small number of subjects and the use of only one criterion for efficiency of concept attainment, but the results support a conclusion that concepts are best conceptualized from materials that are the most direct examples of the particular concept.

Davidson (12), presented subjects with the task of grouping materials of varying levels of abstraction. Davidson considered a category more abstract as it became more inclusive. His experimental materials were photographs, line drawings, long names, and short names of the same objects, increasing in this order in abstraction, based on his definition. Short names were class names and long names were the class name plus one or two delimiting adjectives. Each group of subjects received the same instances, but at a different level of abstraction, and subjects were asked to group the materials in categories of their own making. Subjects using the long names were least able to do this. There was no significant difference among the other groups. These results do not necessarily prove that the class name is more or less abstract than the longer name; instead, it is probable that the adjectives included in the longer name were irrelevant distractors to the subject trying to categorize them.

The preceding studies of comparative efficiency of different types of stimulus material support the general conclusions that the efficiency with which a concept is learned is dependent upon the efficiency with which the experimental materials communicate the concept; that a concept, as it varies from concrete to abstract (or decreases in its perceptual nature) is best derived from material which corresponds to that degree of abstraction or concreteness; and that factors which make the relevant characteristics of the instances more obvious lead to more efficient concept formation.

Another of the factors affecting the perceptual availability of the concept from the materials is not contained in the material themselves, but in the manner in which they are presented to the subject. Bruner (5), found that cards placed in the board in an ordered way which made evident their attributes and the relationships between them tended to help the subject go about his task systematically and remember the information gained. Tagatz (85), found that an ordered board made concept learning one third more efficient.

Perceptual availability of the instances during the course of the experiment determines the role of memory in the concept formation experiment. Reed investigated the effects of serial versus simultaneous presentation of the stimulus material (46). He found that the simultaneous method, in which all instances were available to perception throughout the experiment, yielded a higher percentage of correct concepts than the serial method, because both the supporting and non-supporting evidence was before the subject and he could draw more accurate conclusions. However, as the length of the series increased, the difference in percentage of correct concepts became smaller. Reed (46) also found that the simultaneous method proved to be proportionally more "work" for the subject in a short series than in longer series. This he attributed to a greater proportion of supporting evidence for a wrong concept in the shorter series.

Heidbreder (24), attributed the greater ease of concept formation in card-sorting experiments as compared to the modified memory experiments to the possibility of greater reliance on perception. She didn't consider memory as a factor, but in saying that the simultaneous presentation provided more situational support for concept formation, she was in effect saying that it required less memory. Bruner, too, found that his subjects conceptualized better when the task was "on the board" than when it was "in the head." (5)

Cahill and Hovland (8), using only negative instances, found poorer performance in successive showing of the instances than in simultaneous presentation. The use of negative instances in attaining a concept required more reliance on memory than the use of positive instances or a mixture.

The presentation of negative instances of the concept as part of the concept learning experiment is another factor which affects the extent to which relevant characteristics are obvious to the subject. In learning theories, the presentation of negative instances of the thing to be learned is often considered interference with the stimulus-response association that is being conditioned. Research in concept formation indicates a somewhat different fate for the negative instances of a concept. Whether or not the negative instance is valuable in defining the concept depends upon the amount of information that the negative instance carries, which in turn depends upon the subject's understanding of the limits and dimensions of the concept to be formed. If the subject is taking part in a modified memory experiment in which it is expected that he will, at some point in memorizing, hit upon the concept, a "no" response to an early guess about the concept is not usually informative. If, on the other hand, a subject knows that the experiment is one in concept formation, that the concept which he is expected to form has two relevant dimensions of a total of seven that comprise the instances, the answer "no" to an early hypothesis about the concept can carry a certain amount of information which is helpful in attaining the concept. Smoke (55,56), in his early experiments, found little difference between the use of positive instances alone and the addition of negative instances. Hovland and Weiss (29), also Hovland (28), questioned whether this low efficiency of the negative instance was due to difficulty in using information transmitted through negative instance or because no information was carried by negative instances. They concluded that negative instances do have value under the right conditions, but that subjects have to remember more when they are learning a concept through the use of only negative instances; they have to remember all the things that the concept is not, instead of simply what it is.

It is possible to distinguish between an irrelevant instance and a negative instance. The first, of course, carries no further information for the subject and may serve to increase the complexity of the problem. The negative instance does have value in learning. In a study by Buss (7), subjects formed concepts with positive or negative instances, or both. In the Hovland and Weiss study (29) over half of the subjects gained the concepts when confined to the use of negative instances alone. In the Cahill and Hovland study (8), the subjects also formed concepts through use of negative instances. This distinction has meaning for the teacher and implies that a concept can be clarified by negative instances if the students have a clear idea of the concept with which they are dealing. Irrelevant information, however, does not help clarify the concept, but merely adds to its unclearness.

Buss (7), conducted an experiment in which he varied the proportion of positive and negative instances and found that the more stimuli of one kind presented in the learning of the concept, the greater the tendency to categorize that stimuli correctly. Buss referred to this variable as reinforcement, a term foreign to a discussion of concept formation. Since each instance is slightly different, whether positive or negative, it is not really "reinforcement" of an instance, but the increased experience with instances which do or do not contain the concept, which increases the possibility of categorizing it correctly.

Reed (45), varied the complexity of the stimuli by adding irrelevant and confusing words from the lists the subject was to conceptualize. He measured the amount of work by the number of promptings needed by the subject. The amount of work varied directly with the complexity of the stimuli, and concepts derived from the more complex stimuli were not retained as well as those learned from the simpler materials. The categories tended to be unclear and illogical when confusing words were added.

In another experiment, Reed (44) investigated the effect of the length of the series on the amount of work required. The amount of work was relatively less but absolutely greater to master a long series and more consistent concepts were formed from a longer series. Conceptual behavior has its basis in perceptual activity, as is evidenced by the studies discussed in this section; it is, however, different from perceptual behavior. This study by Reed shows once more the advantages of gaining a concept over attempting to memorize perceptions. The studies above indicate, however, the importance of the perceptual characteristics of the materials in concept learning.

Methodological variables

Of the methodological variables, the most important seems to be a "set" for learning concepts. Subjects instructed as to what a concept was and how it would operate in the experiment about to be undertaken learned and retained concepts better than those who did not receive this set (43). Thus, time was spent in learning to learn. That this learning to learn process is inherent in the concept formation process itself is indicated by the decreasing relative amount of time for a longer series in the Reed study (44).

Another type of set which influances concept formation is that of a previous concept. In an experiment performed with children (47) those who categorized a series of pictures correctly as "people" tended to interpret an ambiguous picture as a person, whereas a group which had been using the concept animal perceived it to be an animal. Meaningfulness of the ambiguous figure was perceived in terms of the concept previously held. The figure that Reese used was shown to be classed as "person" more often by subjects without any set, leading to a less significant difference in this direction than would be expected if the experiment were repeated with a picture which was truly ambiguous.

Another important factor in concept learning methodology has been the means of validating the concept. If the experimenter holds the concept, then the subject must communicate the concept to the experimenter in some way for him to check its correctness. In some studies, the subject is required to complete a sorting or series before he is told whether he is right or wrong. In other experiments, the subject is able to adjust his hypotheses at each presentation of an instance as he learns whether he is correct or incorrect with each try. These two methods have not been compared experimentally. In real life, according to Bruner, we feel the necessity for the validation of a concept only after a certain degree of "risk-taking" is involved.(5) We conceptualize, but we do not care whether the categories are adequate until we stand to lose something.

In the Gropper study (78), students who responded in a programed learning sequence and thus received immediate validation or correction of their concepts made far greater gains when tested than those students who received the instances of the concept without being forced to respond and be correct. Programed learning is a highly debatable subject, but in this study, continual validation did increase the efficiency of concept learning.

The effects of giving more information to the subject after each instance than simply "right" or "wrong" were investigated by Sechrist and Wallace. (52) After each presentation, the subject was again shown the initial positive focus card containing an example of the correct concept. Giving, in addition, either a list of possible remaining hypotheses, or a list of all eliminated hypotheses, or removing from the board all but the positive instances of possible remaining hypotheses failed to produce any reliable difference in the rate of concept attainment. The latter two conditions resulted in an increased number of redundant wrong guesses.

Set for learning concepts and appropriate validation during the development of the concept seems to increase the efficiency of concept learning. Other methodological variables are implied in the task variables discussed previously.

Organismic variables

Organismic variables affecting the concept learning task include the physiological, cognitive, and affective characteristics of the individual.

Concept learning ability clearly improves with age. This is a logical deduction from the definition of concepts as results of experiences. However, opinion now ranges from the idea that it is possible to teach a child anything in an intellectually honest way if the idea is simplified enough (4: 12), to the contention that concept learning ability is dependent upon maturation (69, 60). Zazlow (74), found that the ability to think abstractly was associated with age. Most children under eleven years in his study tended to form pairs instead of the concept of a continuum which was intended. Flizak (77), investigated concept attainment ability in college undergraduates and older graduate students and found that the younger students attained more meaningful concepts in a shorter time. The nature of the graduate students (they were enrolled in summer school courses) leads to the suspicion that the two groups differed in intelligence as well as age, but this factor was not determined.

There have been no reports of experimentation directed to discovering the level of concept attainment which is attainable during adolescence. The Runquist study (49), showed a significant increase in ability to learn concepts with increase in grade level, but this finding related only to number of concepts learned, not to variations in levels of concepts. The introspective approach of Piaget will not be reviewed here because it has little relevance to the problem at hand, being merely descriptive of the concepts normally developed at various ages, rather than predictive of capacity for conceptual development. This introspective approach supports the idea that concepts are developed in a hierarchical fashion; an example of the type of study done by Piaget is found in a study by Russell (51), in which children of different ages were asked, "Is this living?" about various objects. Russell found four development stages in the child's concept of living. Wolfe (73) also found increasingly abstract concepts with increasing age using a quantative approach rather than an introspective one.

In several experiments in which attempts were made to develop concepts at early ages, results were inconclusive. Welch (67) found that the "concepts" he introduced were more nearly arbitrary associations in children of pre-school age. Suppes and Ginsberg (60) had some success in introducing abstract mathematical concepts in a group of kindergartners and first graders. Zazlow (74) found that most of his subjects below the age of eleven were unable to gain the concept of his continuum.

According to the literature on concept formation, age affects concept learning ability in two ways. With increasing years come the increasing experiences from which concepts are developed. Since concept learning has a "learning to learn" effect, increasing opportunity for concept formation improves the ability. More important, age brings maturation of the ability to think more abstractly.

The relationship of concept formation and other physiological variables has not been established, nor is any relationship with affective variables experimentally supported, although experimentation with other kinds of learning shows these to be factors. Observation would permit a guess that there is some relationship with concept learning as well.

The relationship of concept formation and mental age is a complex one. Intelligence tests are partially composed of items which test certain concept formation abilities or the possession of certain concepts. Hoffman (27) proposed a test of intelligence consisting entirely of noverbal concept formation items, which he felt would measure basic intelligence and eliminate the problem of interpreting test scores in light of environmental experiences.

Zazlow (74) found that mental age became a more important determinant of concept formation ability than chronological age only after a certain age level (sometimes during adolescence) had been reached. Mental age was a more important determinant, however, in those of below normal intelligence (74, 32). Those of subnormal intelligence have not performed as well in concept formation as those of average or above IQ (36, 57). Retarded adolescents in two studies reported by Griffith (17, 18) had to define two-thirds of the words in lists in order to arrive at the common abstraction. Normal subjects in the same study could operate with fewer "verbal mediators." Iscoe and Giller (32) found that retarded subjects tended to demonstrate "privateness" in conceptualization; they did not use the generally accepted concept of a thing but developed their own categories. The writers suggested that the environment of a retarded child tends to become increasingly different from that of a normal child as the retarded child grows older and his disability becomes more recognizable. They stressed the need for "continual training and stimulation" (32) so that privateness does not develop.

Levy and Cuddy (37) found that the educationally retarded or underachieving child differed in concept formation ability from others of normal intelligence. The lack of stimulating experiences is often the cause of educational retardation and has been shown to be a reason for the lack of well-developed concepts as well. It is possible that the reason for lack of concept formation ability in the educationally retarded may be the result of lack of experience with the formation and use of an adequate concept system.

Differences in concept formation ability in subjects within the normal ranges of mental ability have been observed by experimenters such as Heidbreder (24) who found that lower mental age resulted in slower performance and difficulty in changing the basis of sorting.

Two studies concerned with the relationship between concept formation ability and cognitive variables other than intelligence test scores have obtained different results. Baggaley (1) found such variables as strength of closure, deductive reasoning, analogical mastery, inductive reasoning, and speed of closure to be significantly related to increasingly high levels of conccept formation. Lemke (82) found only a slight tendency for cleverness and conceptual foresight to be associated with the efficiency of attaining a concept. The difficulty with both of these experiments probably resides in the tests of cognitive abilities used, most of which are not regarded as highly reliable instruments. It is likely that, as Heidbreder and others suggest, the relative importance of conceptual as compared to perceptual factors in gaining a concept depends upon the characteristics of the concept or the nature of the instances from which it can be derived.

Strategy

Klausmeier's fourth category of variables in the concept learning process is strategies, which pertain to the means the individual uses to attain the concept.

Hanfmann and Kasanin (19), in developing materials for studying concept formation, found that subjects differed widely in their approaches to the problems. Those who had what the experimenters termed a "categorical attitude" were far superior to those who did not. Several other experimenters have noted a difference in their subject's mode of concept attainment. Goldstein and Scheerer worked with normals and mentally impaired subjects; they concluded that abstract and concrete attitudes were not habits or sets but capacity levels. (16: 3) An abstract attitude was defined as one which embraced more than the present perceptual qualities of a stimulus. Baggaley (1) used all normal subjects and found two modes of behavior which he termed analytic and non-analytic. Some subjects began immediately to search for a principle, while others relied more heavily on amassing a certain amount of perceptual data, hoping the common features would stand out. Heidbreder stated that the more perceptual the conditions of the experimental task, the easier it was to perform the conceptual task. She proposed that the means an individual uses to attain a concept, whether more largely conceptual or perceptual, depends sometimes on the individual and in other cases on the characteristics of the situation. (24)

Bruner, Goodnow, and Austin (5) considered concept formation as a process of making a series of decisions. They termed the patterns of decision used in the "acquisition, retention, and utilization of information" the strategies of concept attainment. Bruner stated that the objectives of any strategy should include insurance that the concept will be attained after a minimum number of encounters with relevant instances, that a concept will be attained with certainty, regardless of the number of instances one must test en route to attainment, and the minimization of the amount of strain on inference and memory capacity while at the same time insuring that a concept will be attained, and the number of wrong categorizations prior to attaining a concept. (5: 54)

It was hypothesized that the "basic processes of categorization are the same, even though operating under different conditions of attribute immediacy and under different conditions of life history in the organism," (5: 10) a conclusion not unlike Heidbreder's cited above. Bruner's study dealt only with concept formation as the categorizing of discriminable attributes, operating in a narrow range of the vertical dimension of concepts; but Bruner's contention was that concept formation is always a matter of categorizing although under different conditions and at different levels. The value of the Bruner study is that it is the first study of the kind to actually analyze behavior during concept formation.

An everyday example was given by Bruner (5) to show that the decisions the subject makes during the course of an experiment were comparable to those used in all categorizing activity. The situation is that of a foreigner who is being introduced to the people of a town. After each meeting, the friend who is introducing him tells him whether or not the person he has just met is influential. Soon, the foreigner wonders what attributes of a person label him as "influential", so he begins to note differences that might have an effect, and begins to hypothesize rules for "influential-ness" with which he anticipates his friend's categorizations in his future meeting of townspeople. These hypotheses are confirmed or eliminated by his friend's statement and are maintained or changed accordingly until the visitor knows what attributes classify a person as influential in that town. (5: 52)

Bruner investigated several conditions of concept formation which can be illustrated with the same example and which have relevance for concept learning in general. The visitor will adopt a different strategy, or pattern of decisions, if he is allowed each time to choose the next person he will meet. He is then able to control the attributes which are present in each instance, or meeting, and can choose the attributes he wishes to test. He has a choice of four approaches to the task: He can hold all possible hypotheses in mind and the objective of each of his choices will be to eliminate as many of the remaining hypotheses as possible. This is the most difficult strategy in terms of cognitive strain. Second, he can test one hypothesis at a time and choose to meet people who provide a direct test of each hypothesis. This will be a wasteful approach, because each meeting could provide a test of many more than one hypothesis. Third, the visitor could find one person who was "influential," discover his attributes, and next choose to meet a person who differed in only one of these attributes. In this case he learns something from any guess, right or wrong. Or last, in a modification of the last strategy, the visitor could choose a person who varied in more than one attribute from the person he already knew to be influential. If he is right, he learns much more from such a choice than in the more conservative strategy above. However, if he is wrong, the negative instance yields uncertain information.

These strategies were experimentally constructed and tested. Bruner termed them, in order, simultaneous scanning, successive scanning, conservative focussing, and focus gambling. Conservative focussing was found to be the most economical in terms of memory requirements and reduction of risk. Focus gambling involved taking a greater risk and was best utilized if there was no time limit, or if the consequences of any one decision were not important to the subject. In all of these approaches the visitor or the experimental subject with the opportunity of selecting instances for testing was using a "selection" strategy. (5: Ch. 4)

If the visitor, on the other hand, must meet the townspeople in a sequence which he is not free to change, he then changes to some kind of "reception" strategy. He forms an hypothesis after one of the first encounters. This process takes one of two forms. The visitor may use all the attributes of the first influential person as his hypothesis, comparing each successive positive instance with the first, noting each time which attributes have been eliminated. Or, the visitor may hold an hypothesis based on only a portion of the attributes of the first influential person. For some reason, or perhaps for none, he bets that certain attributes are more relevant than others. When his hypothesis is not confirmed, he then has to backtrack to test the remaining attributes of the initial positive instance. The latter process clearly requires more strain on the memory, and, depending upon the scope of one's partial hypothesis one may never encounter an instance of it for testing. Using this part-scanning strategy, as it is called by Bruner, forces the visitor to be constantly alert to all attributes of all instances for he never knows when he will have to revert back to them for needed information. Bruner found that his subjects showed a preference for the "wholist" strategy, and that a greater percentage of problems was solved by this means. The partist strategy can be used until the problem becomes complicated by an increased number of attributes, time pressures, or other strain-increasing factors, whereupon the subject finds it more and more difficult to follow the rules of the strategy. (5)

The time factor is a confusing one. Harris, in a later study (79) pointed out that subjects differed in the rate at which they processed information. One subject might spend much time using the smallest possible number of instances; another might make use of many more instances than necessary but achieve the concept in the same or smaller amount of time.

Wiersma (86) referred to a strategy as a learning to learn procedure. He described a strategy as a "cognitive control within the organism which determines the selection, recall, and utilization of information in attaining concepts." (86: 11) He was able to reproduce in his subjects variants of conservative and gambling strategies which corresponded to those that Bruner had previously identified. Klausmeier (80) investigated the relationship of strategy and efficiency of gaining concepts. Gambling strategy in which the first hypothesis was correct, of course, proved most efficient; the conservative strategy was next in efficiency. This held true across age differences and differences in the type of stimulus in which the concept was embedded. The experimenter eliminated the possibility of the subject using a scanning strategy by providing a focus card and explaining that it was a positive instance of the concept.

The analysis of the concept learning process in terms of strategies is a useful one. It has not yet been extended to apply to hierarchical categorization in an experimental situation. It is likely that the strategies of gaining vertical concepts will vary from those already identified, as strategies of selection and reception have been shown to vary. The study of strategies of concept formation has simplified the confusing role of memory in the analysis of concept learning. In this analysis, only one perception is dealt with at a time, whether the succession of these perceptions is immediate or separated by periods of time. The strategy used determines the extent to which memory is necessary in the gradual evolution of the concept. It is possible to reduce the need for memory by the appropriate strategy.

Klausmeier suggested that children in school could learn these strategies. (80) No experiments have yet tested this proposal, but it seems that means of approaching problems efficiently could be taught. Piaget's proposition that adolescence marks the beginning of logical operations in concept formation (62: 100) indicated that adolescence is a critical time in the acquisition of adequate concepts and the development of conceptual abilities.

In this section, the task, methodological, organismic, and strategy variables in concept learning have been discussed by means of a review of the experimental literature on concept learning. It is possible to conclude tentatively that, given a normal range of subjects' intelligence and childhood, the extent and efficiency of concept formation can be affected by the manipulation of the task variable, the materials and experiences with which the subjects are confronted. The task affects the strategies which can be most efficiently utilized in learning the concept as well.

In the following section, the use that several subject matter fields other than home economics have made of the concept approach in improving high school curriculums will be surveyed. These changes were originated and have occurred with the continual goal of increased student learning and understanding. It is possible to discover elements of these programs which concur with experimental findings about the process of concept attainment and with the logically derived explanations of concepts and concept systems.

CHAPTER IV

GENERAL USE OF THE CONCEPT APPROACH

Changes in high school science curriculums are largely the result of a Course Content Improvement program of the National Science Foundation. "Support is granted to first rate scientists and teachers, working together to do research and development on course content." (48: 2) The Course Content Improvement program was not ostensibly a plan for the concept approach to the curriculum. Yet, in the means that were taken to improve the curriculum, the result was a concept approach in the broad and fruitful sense of the word. The financial support of the National Science Foundation has made possible not only an analysis of course content, but also the development of books and teaching aids that provide integrated experiences from which scientific concepts can be formed.

Study committees were formed in biology, chemistry, physics, and mathematics. A review of the accomplishments in each of these areas by individuals who were involved in the work can be found in The School Review, Spring, 1962, which is the source of the following discussion of these committees' work.

The Biological Sciences Curriculum Study Committee agreed on several points of departure for their study. Knowledge in the biological sciences doubles every ten to fifteen years, making it impossible to cover all the significant aspects of the subject matter, and leading to a failure to teach up-to-date biology. (15: 17) Another difficulty they saw was that of the tendency to teach biology "as essentially a body of information established as true, together with concepts and laws of nature assumed to be unchangeable, irrevocable, and prescriptive." (15: 18) The goal of the new course would be to "thread the great biological themes and concepts through the entire fabric of whatever materials might be prepared for students to use." (15: 17) During the summer of 1960, scientists, teachers, and writers gathered for seven weeks and wrote three versions of the course material, each attempting to use a different organizing concept. In the fall of 1960, the courses were taught by teachers who had been briefly introduced to them as soon as the materials developed during the summer were published. Staff members of the Curriculum Committee visited classrooms to obtain information about the programs. Evaluation of the programs in the summer of 1961 revealed that the goals had not been met; the "great themes" had not been central; in fact, it was felt that there was still over-emphasis on facts.

During the summer of 1961, the materials were revised, with particular attention to improving organization and focusing on the "great themes." The laboratories had been intended from the beginning to get away from "sheer cookbookery, a ritual of recipes." (15: 29) There was great response at once to this approach in which the laboratory was a period of discovery rather than an illustration (15: 29). This approach was also intended to promote the attainment of a concept of the scientific process. The laboratory materials lead the students into conceptual processes, by helping them make accurate observations and ask the right questions about what they were doing. The aim of the approach is "to lead the student to understand scientific methods of investigation" (15: 31) as well as to relate his knowledge to the "great themes." (15)

The Chemical Bond Approach Project hopes to produce a course that "will reveal the importance of theory and experiment," (59: 44) the underlying conceptual structure of the subject matter. The nature of the subject calls for the conception and use of many classifications. These classifications, in turn, are the basis of the theories. Materials were developed which are intended to provide both verbal and visual experiences with the concept of chemical bonds, the unifying approach of the whole course plan. (59)

Another approach to curriculum study on chemistry, the Chemical Education Material Study, was undertaken with a similar emphasis on laboratory experience. The programs of laboratory work provide that the student will spend the first few weeks of the course in the laboratory making observations of scientific phenomena that will be dealt with later. This is termed the "overview" period. The student is guided by the teacher and by the manual in abstracting from these experiences, but the process requires the active participation of the student, and no rules, classifications, or formulas are given. These the student derives from his experiences, which are designed and organized to point the student toward the formation of the concepts that are basic to an understanding of chemistry and provide a framework for the rest of the course by means of the expansion of these concepts. (59: 57) As a result of the overview preceding the course itself, the student "has a comprehension of how (concepts) fit together even before each one is developed in detail. He has also developed a desire to understand general concepts in more detail, since he has seen that they do indeed fit together and give a coherent over-all picture." (59: 58)

Later in the course, the textbook and laboratory materials encourage the student to use the concepts he has gained in new situations. "He is encouraged to perform experiments and to interpret them in terms of the concepts he has learned." (59: 59) He is led from simple situations to more difficult ones and sees that the fundamental principles are the same. Films are being developed by the CHEM Study "to enable the teacher in the classroom to illustrate experiments and concepts that would be difficult to illustrate in any other way." (58: 61) The films are planned to be included at a specific point in the course in order to contribute most efficiently to the concept development. (58)

The Physical Science Study Committee was the first of the joint efforts of university and secondary school teachers working in such an organized way to improve the secondary school curriculum. As in the biology and chemistry programs, the major contribution of the committee was the introduction of teaching materials that would result in a physics course which would be concerned with the development of the ideas that are central to our understanding of the physical world. The result was a

> course dealing with physics as an explanatory system, a system that extends from the domain inside the atom to the distant galaxies. The course tells a unified story, one in which the successive topics are chosen and developed to lead toward an atomic picture of matter... The student should see physics as an unfinished and continuing activity...This deeper development meant carrying key concepts to higher levels than have been ordinarily reached in secondary school courses...The student is expected to be an active participant in this course. (13: 65)

The emphasis on the technological aspects of physics has decreased in favor of dealing with the ideas, or concepts, which provide a framework for further learning. "...the emphasis in the course on experiment and experimental style is meant to foster insight into the role of experiment in the generation and refinement of physical ideas." (13: 67) In addition to textbooks and laboratory materials, the teachers of the PSSC course can also make use of a lengthy series of paperback books and two batteries of achievement tests which have been prepared for the course.

PSSC students take a separate college board examination in Physics because their course has been so different from the conventional physics course. In college, PSSC students do as well and better in some respects, such as "grades...flexibility of thought, and procedures..." (13: 79) because of the kind of thinking students in the new curriculum have been prompted to do. (13)

In mathematics, National Science Foundation support has made possible the same kind of study and production of materials for a changed curriculum as in the sciences. The reason for the need of curriculum changes are much the same as in the other sciences: "... mathematics is constantly being reformulated: its language and its conceptual apparatus change faster and faster as time goes on; some ideas and methods lapse into relative insignificance, while others move into central roles." (41: 84)

This committee also saw the necessity of incorporating the new course into a textbook; the available ones did not serve the purpose. Moise, who reported on the new program in The School Review, pointed out that, "It is well known that almost any course works if it is taught by its inventors...It is...doubtful whether the feasibility of a really new program can be judged until books have been written for it." (41: 87)

There are several different groups working on mathematics curriculums. One of them takes the position that "mathematical knowledge need not always be verbalized at all and that at some stages the student learns better if he is not asked either to produce or to read verbalizations. The other group disagrees and insists that "the ability to verbalize must be, at some point, an objective in itself. The alternative is mathematical illiteracy." (41: 93) The difference has not been resolved; both groups have programs now in effect and each has its advantages and disadvantages.

The groups considered the effect of intelligence in the ability to respond to the new courses:

> The new books try very hard to convey mathematical concepts. From this it should not be inferred that they are addressed solely to the superior student...It is the mediocre students who need the most help in grasping concepts: the brilliant students are more likely to figure things out for themselves. (41: 100)

This committee is also concerned with mathematics education in the elementary schools. "One of the great successes of the curriculum work on mathematics sponsored by private foundations as well as the National Science Foundation has been the demonstration that rather sophisticated mathematical concepts can be written in a way that is intelligible, understandable, and useful at different stages of mathematical development." (40: 105) For example, the introduction in elementary terms of the set theory has been the unifying principle from the fourth grade on, and forms a basis for easy transition from number computation. The National Science Foundation has made this research possible; courses have been planned and tested under experimental conditions and the experimenters have been able to introduce concepts successfully at age levels much younger than had been thought possible. (40: 109)

These new courses in mathematics and the sciences reject the idea that learning is the memorization of facts. Francis Chase, proponent of the new curriculum summarized the value of the new approach:

> In the proposed organizations of the curriculum, all pretense of covering the field of knowledge is abandoned, and reliance is placed instead of apprehension of a system of basic concepts and their logical consequences. These concepts serve not only as a structure for holding related bits of knowledge, but also as perspectives through which to view phenomena--perspectives moreover that are recognized as partial and temporary in nature and, therefore, to be supplemented and/or replaced in time by other perspectives... the new curriculum theory emphasizes the acquisition of concepts that enable the learner to perceive in familiar and subsequently to-be-encountered phenomena, relationships that would otherwise be obscure. (9: 134)

Jerome Bruner, in his book, The Process of Education (4) discussed the importance of the work that has been accomplished by these study groups. His major point throughout the book is that the process of education is the learning of structure--"To learn structure, in short, is to learn how things are related." (4: 7) Once grasped, the structuring of experiences helps a student recognize "variant on a familiar theme." (4: 8)

Bruner made another interesting point..."It may well be that the style of thought of a particular discipline is necessary for a background for learning the working meaning of general concepts." (4: 28) This relates to the theories of strategy in concept attainment, which hypothesize that the strategy employed depends upon the type of concept, the context, and the consequences of the conceptualization. If the experiences leading to concept attainment are guided, or the strategy prescribed, (if this is possible) then the "style of thought" should reveal itself in the organization of the experiences and the information the student is expected to gain.

Understanding the fundamental structure (or concept organization) of a subject reduces the gap between elementary and advanced knowledge. (4: 28) It will no longer be necessary for the college freshman to unlearn misconceptions allowed to exist in the old curriculum, because there was less direct attention to this and because classroom experiences were not devised to reveal and eliminate misconceptions, or because certain misconceptions were overlooked in the attempts to "cover everything."

The concept approach has been proposed for other fields of study for much the same reasons as it has been used in the sciences and mathematics. The social studies field is a good example. It also has seen a vast increase in the amount of information that should be taught. Platt (42) wrote that "...much has been said lately about the possibility of orienting a social studies program toward a concept development approach." (42: 21) He pointed out that the most obvious addition of material to be taught is the result of the emergence of Asia and Africa; in view of the fact that there is no extra time in the school year, there has been a tendency to water down material to cover all of it. Platt stated:

> An adoption of a concept-developmental approach to social studies is an attempt to include the emerging areas and the more modern research data by cutting through the accustomed subject matter presentation and stressing the importance of a limited number of concepts which transcend the increasing number of specialties within the social sciences. (42: 21)

No steps have yet been taken in the social studies to compare with the comprehensive changes that have taken place in mathematics and science curriculums. One obvious reason is that the sciences have had a source of financial support in the National Science Foundation. Without such support, work in other areas, including home economics, will, of necessity, proceed more slowly.

CHAPTER V

USE OF THE CONCEPT APPROACH IN HOME ECONOMICS

It is desirable, after all of the preceeding discussion, to put the "concept approach to curriculum" in perspective before continuing. A brief summary of the sources of a curriculum was given by Telfer, who said that curriculum must be an outgrowth of the philosophy of education that is prevalent, an outgrowth of the studies on contemporary society, an outgrowth of studies about children and the process of learning, and it must be derived, too, from the suggestions of subject matter specialists. (61) No attempt will be made to discuss all of these forces, but it is important to recognize that a curriculum is more than a guide to the processes and products of learning.

It is this writer's conclusion that suggestions and materials for implementing the curriculum should be an integral part of a curriculum that is organized around concepts. Identification of these basic concepts of fields by those who are specialists in these fields is certainly an important first step in making a curriculum of this type. But, as has been seen, the curriculum study groups in the sciences, which were of approximately the same composition (teachers and experts) as the curriculum groups in home economics, began immediately to "organize concepts into appropriate learning units." (35: 182) Almost as soon, they realized that the ultimate success of any curriculum work would rest in the experiences teachers provided their students and the effectiveness of the materials they used. These groups felt that the only way to assure success for their program was to write textbooks and supplementary books, provide lab manuals and teacher's manuals, and make available special equipment and visuals, which helped the teachers communicate the concepts and gave the students experiences which embodied the desired concepts and led to their development.

It seems that an approach of this kind is both desirable and necessary in home economics. The situation is much the same as that in the sciences. First, the limits of the field are expanding and, at the same time, the amount of information in all areas of home economics is increasing at a rapid rate. Brownell and Henderson stated:

> No one knows how many concepts are taught in the school. Their total is, however, very large, indeed...the number of concepts to be taught must be reduced through elimination of the less essential ones, in order to assure sound learning in the case of the concepts that are retained... (moreover), many as are the concepts taught in the classroom, far greater is the number acquired with or without instruction in life outside the school. (3: 105)

Other writers, as well, feel that the number of concepts (they are referring primarily to nominal and class concepts) taught should be reduced even though the potential number of concepts to be learned in a field increases. In the sciences and in home economics, the concepts are undergoing change as well as increasing in number. All these factors point to the organization of curriculum around broad concepts, which both "condense" the subject matter more efficiently and serve as a framework for the incorporation of changing ideas.

Even if the teacher's time were not to remain limited, it is probable that in many schools the abilities of the students who elect home economics will, in general, remain so. Figures in a number of schools surveyed by Conant (10) show that to high school home economics come many students who cannot profit from the academic or commercial courses their schools offer. (10: 121-130) In this, of course, the science curriculum differs from that of home economics. In the sciences, curriculum makers are concerned with articulation between high school and college level courses. In home economics, the aim is to provide students with concepts that are useful to them presently as individuals, family members, future homemakers, and probably, working mothers.

Kirk and Johnson, in Educating the Retarded Child (34) said that

> Much work in the technical aspects of music goes beyond the abstract abilities of mentally handicapped pupils. This is also true of home economics, where teachers are accustomed to devoting many periods to the scientific aspects of food composition, the use of fabrics, and the theories of home decoration and management. (34: 204)

What Kirk and Johnson said probably has some basis in fact; however, as has been previously pointed out, it is the less able students who most need training in perceiving features and relationships and in organizing their experiences meaningfully. The more intelligent students can. if need be, do this more or less spontaneously.

The research on concept formation has indicated that the concept approach to teaching can help students learn to learn. No research has yet shown that it is impossible to improve in conceptual ability with training and practice. The processes involved in concept formation have been shown to improve with practice. It is certainly worth the work of providing organized experiences and clarifying meanings at every step, in the attempt to improve conceptual ability and give students a framework with which to approach life's many similar, but different, experiences. Use of the concept approach, then, seems to have implications for upgrading the curriculum, even in the case of the slow student.

If the goal of the curriculum is the communication of the structure of the subject matter to the students, especially prepared curriculum materials will keep this structure before the students in all their classroom experiences. Students, especially slow ones, must sense the organization of the subject matter if they are to acquire the concepts with which it is organized. This is difficult for the teacher to arrange with such disorganized materials as are now available.

Providing teaching materials as an integral part of the curriculum is an expensive undertaking, and one which was made possible in the sciences by a Ford Foundation Grant. Its importance is demonstrated by the fact that at present, a major concern of the New York State Curriculum Revision committee is that there are no appropriate textbooks available for the new curriculum they are developing. (75)

Added to the problem is the fact that supplementary material in home economics has, for the most part, been provided by many commercial concerns whose products are used in homes. In areas of home economics which do not involve the use of commercial products to any great extent (child care and development, family relations, home nursing, and certain aspects of housing), supplementary materials are very hard to find. Where leaflets, films, and other visuals are prepared by various companies, all with different points of view, all trying in varying degrees to sell a product, learning with the use of these must be reduced to factual learning. The use of these is not to be completely ruled out, as these are real-life materials and students should be able to judge and use them. However, the materials used in learning concepts should emphasize the broad concepts being used to organize the course, if they are to contribute to the efficiency with which these concepts are to be learned.

The strategies of concept formation depend upon instances of the concept that differ from one another in ways that class them as an example or non-example of the concept. Developing real-life concepts likewise requires series of experiences that are both similar and different. A concept, by definition, cannot be acquired through one experience with something that is a "positive instance" of it. To provide a series of varied experiences in the home economics classroom, some may be direct, but some must of necessity (scarcity of time and facilities, and the nature of the situation) be vicarious.

Direct laboratory experiences which are built up in a logical sequence designed to promote concept learning could be developed as part of the curriculum and made available for students in a modified version of a science laboratory manual. This would have the advantage of keeping the students continually aware of what they are learning from the situation. It would also tend to result in an organized approach in the laboratory.

Only national cooperation in building high school home economics curriculums would make possible the development of correlated textbooks, pamphlets, films, filmstrips, tapes, demonstration equipment and other illustrative material for providing more indirect, or vicarious experiences for the students. In order to teach for conceptual learning, more and somewhat different types of teaching materials are needed.

For example, it is difficult for the teacher to accumulate enough visual examples to enable students to gain a concept by a sorting procedure, common to that used in experiments, where the students actively discriminate between a series of illustrations and develop their own categories. The example that comes to mind out of personal experience has to do with housing styles. It was difficult to collect enough pictures of houses of the various periods of American domestic architecture so that the students could sort them according to their perceptions of the common characteristics before being "given" the characteristics by the teacher. This type of material, examples of categories of this sort that the students are expected to learn, could be collected, reproduced, and made available to teachers for use with the curriculum.

A teaching method that might be exploited in concept learning is programed learning. The evidence that concepts are evolved in small steps, and are more efficiently learned when there is active behavior on the part of the learner, and when there is opportunity for validation of the evolving concept, seems to indicate almost unquestionably the use to which programed material could be put. Instead of requiring simply a conditioned response as many do now, a program intended to convey a concept would use each frame as an instance, require the student to perceive the relevant elements of the instance, and use the information to adjust an hypothesis (in the case of acquiring a concept) or clarify a concept (in the case of a concept already held). Misconceptions, when revealed, would call for a branching technique in the program to correct the concept. Programs could be used by a whole class, or by individual students whose needs or abilities call for a more complete concept, or when misconceptions occur in individual students.

Programs could be used in conjunction with demonstrations or laboratory projects, to insure that the students' concept formation proceeds in small steps. "Strategies" of concept attainment could easily be built into programs, because the author of the program controls the questions that are asked and then corrects the decisions that are made. Logically, this seems to be an appropriate use of programs for learning to learn as well as for development of the concepts included in the curriculum. It is obvious that without new methods and materials, a new curriculum will mean nothing more than rearranging the sequence of experiences which have already been used by the teacher, perhaps eliminating, adding, or changing emphasis on certain portions of information to be "covered." Materials of the sort described are necessary for the communication of the curriculum to the teachers, as well as to the students. It is observable that a new course may be extremely successful with the teacher who originated it, while the same course can flop miserably in the hands of another teacher. There must be more available to the second teacher than a printed outline of the organization of the course. If the first passes along most of the materials that were used and suggestions for their use, it is much more likely that the printed objectives will be met. The second teacher can, of course, make changes, but these, too, are given direction by what has been made available.

The funds available to the science curriculum group also made possible a year of experimentation with their new materials in classrooms across the country, resulting in revision of portions of the course outline or materials which were not effective. This is essential. Presently, with such emphasis in educational circles on evaluation, it is unthinkable that a curriculum be revised and put into effect without a full attempt to compare the development of concepts with that under the previous curriculum.

1. The "Conceptual Mode" of Teaching

In the experiments in concept learning that were previously described in detail, several points of procedure are of note: The experimenter never "gave" the concept outright; he provided the materials and experiences for the subject to discover the concept; the experimenter was always in possession of the complete, correct concept, and was in a position to guide and validate the behavior of the subjects; the concepts always evolved from a series of small steps; in the cases (Bruner's "focus gambling") where the subject attempted to skip some of the steps in evolving the concept, the possibilities of an incorrect decision resulting in much backtracking increased; in the later experiments, the instructions to the subjects have been more explicit as to what was expected of them and how they were to go about their task; the experimenter checked their understanding of this before proceeding.

This procedure is one of carefully controlling the elements of the situation, the instructions to the subjects, and the nature of the material presented in the "instances," but leaving the individual free to make his own decisions, subject to validation, in arriving at his conclusion.

One may draw, from the material on concept formation reviewed in this paper, at least the following implications for teaching:

Limit the number of concepts to be taught; the process of forming and developing a concept is a complex one.

Do not expect the important concepts, once selected, to be acquired in their entirety in the early stages of learning. (3: 113) Many experiences with the concept, in varied contexts, and gradually increasing in complexity are needed to increase its meaningfulness to the student.

"Organize concepts into appropriate learning units." (35: 182) Appropriateness is determined by the extent to which the organization of learning units approximates the structure of the subject-matter.

(1) "Teaching concepts may be regarded as the guidance of reorganization." (3: 113) The structure of the course should be obvious and coherent to the student; Bruner said, "To learn structure is to learn how things are related." (4: 7)

(2 Concepts are not *given* to the students as information is given, or "covered." The teacher, however, can, and should give a *set* for learning concepts.

Consider the characteristics of the students, especially their previous experience with the concept.

3 Perception should be trained, because it is the basis of correct concepts. The student should be continaully asked, "What do you see in this situation?"

Abstraction, as well, should be trained, by requiring the student to answer such questions as, "What do you see in this situation that is common to, or distinguishes it from, another similar one?"

Generalization is used in answering, "From what you already know about this, what do you think will happen in this new situation with which you have been presented?"

Help students form accurate denotative meanings by improving discrimination and by giving "concise, clear meanings." Make students aware of the influence of connotative and intentional meanings.

In the experiments in concept learning, efficiency depended upon using all the information available in an instance. This can apply in the classroom, too, and the teacher should take steps to insure that students are learning all they can from each classroom experience. Instilling an attitude favoring this kind of economy in the students is advantageous to them in their everyday life.

Guard against experiences which are educationally useless because no attempt is made at concept formation, or which are irrelevant in terms of the concept. Confusion or misconceptions may result.

Use negative instances carefully, to increase the clarity or meaningfulness of a concept, the boundaries of which are already known by the students.

Attempt to rid concepts of any disjunctive aspects, if possible.

Aim at the elimination of verbalisms, which are memorized without being meaningful. (71: 220)

The teacher must herself have well developed, accurate concepts in order to communicate them and provide experiences for learning.

(4) Experiences with a concept can be direct or vicarious; the former is more efficient in learning, if the nature of the concept and other conditions allow it.

Use materials which embody and emphasize the concept to be taught, and which promote abstraction and generalization.

Allow for the manipulation of materials if possible. Concrete experiences aid concept formation.

"Provide for active, searching behavior," (35: 182) somewhat comparable to Bruner's "selection strategy."

"Provide for applications of the concept," (35: 182) in novel situations.

Provide frequent opportunities for students to validate concepts in their course of development.

(5) When misconceptions occur, they "imply incomplete and distorted learning." (3: 115) Clearing up a misconception can be an opportunity for constructive teaching. As with the use of negative examples, it is important to know what the concept is not, as well as what it is. Don't attempt to save time by giving the right answer.

Attempt to build concepts in the dimensions discussed previously. Proceed in small steps from simple to complex, concrete to abstract, and vague to meaningful. Develop concepts in both the vertical and horizontal dimensions and aim at correct extensional and intensional meanings.

Emphasize the importance of using concepts developed in school experiences as a means of organizing experiences in the home and elsewhere.

The nature of a concept is that it is always undergoing change. The conceptual approach is especially relevant in learning to deal with a continually changing world.

Students should learn that many concepts are by nature flexible. This is necessary to avoid the danger of thinking of concepts as precise definitions or rules and might be accomplished by posing situations in class which require flexible thinking.

"Aid the learner to evaluate the adequacy of his concepts," (35: 182) to "explain and critically evaluate (his) own concepts and the process through which they developed." (6: 162)

2. Implementation of a Concept Curriculum

The first steps in using the concept approach, identifying basic concepts, and organizing them into appropriate learning units, has been the work accomplished thus far by the committee that is revising the New York State Home Economics curriculum. Following is the basic structure and time allotment of a course proposed for the early high school years (probably tenth grade) by the New York State Curriculum revision committee:

I. The role of Management in personal and family life

½ week A. The concept of management
assumptions
outcomes

½ week B. Management as influenced by individual and family values and goals

½ week C. Resources for Management

½ week D. Parts of Management

II. Application of Management to some concerns of family living

3 weeks A. Management in the maintenance of the home and its furnishings

3 weeks B. Management of space for storage in the home

9 weeks C. Management in feeding the family

9 weeks D. Management during family illness and accident

9 weeks E. Management in personal dress for work and travel (82)

This outline, somewhat expanded, is accompanied by a series of behavioral goals for each area above, and a detailed outline of content. A study of the process of concept learning indicates one major change that might be made in this plan. Management, as the curriculum makers hope it will be understood, is an abstract idea. It is an ideal organizing concept for a home economics course because implicit in it is a means of coping with change and meeting new situations. The job of eliminating material to make a comprehensive, yet manageable course of study in the face of rapid expansion of the field, is facilitated by using management as the organizing concept. If, for example, a concept such as "organization" is acquired by the student, then much factual material about how to approach a whole range of specific situations is unnecessary.

If one is going to proceed from the simple to the complex in concept learning as experiments have shown is most efficient, then the above curriculum might begin with the concrete experiences with "management" that are scheduled after a discussion of the "idea" of management in the New York State curriculum. Rather than beginning to build the concept of management by verbalizing it, the student would better profit from this more concrete approach. This writer proposes an "overview" period, like that used in several of the science curriculums, in which the first weeks were spent giving a broad view of the course concepts by means of relatively simple, concrete experiences. After this overview period, which establishes a framework for the remainder of the course, various aspects and applications of the concepts are explored in depth.

The concept, "management" can be seen as having a structure which itself ranges in the dimensions of concept formation discussed previously.

Organization

more simple, concrete	in:	foods clothing housing	in:	school home work	of:	time energy other resources

Decision making

more inclusive

↑ Vertical development ↓	strategies: information gathering predicting consequences testing evaluating	in:	foods clothing housing	in:	selection use care	concerning:	time money other resources

implicit in organization and decision-making	(Standards (Goals (Values	relation to immediate situation source changing nature individual family
	(Management	influenced by individual and family values resources — responsibilities parts of management — practice

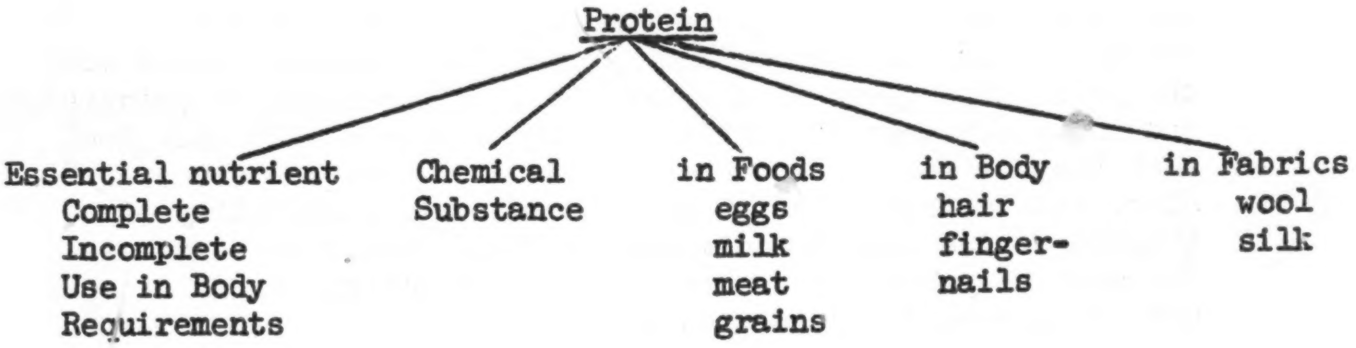
←——— Horizontal development ———→

It must be remembered that the concept of management in personal and family living is probably a new label for a something already in the experience of most students, although to a limited extent. It is the aim of the new course under discussion to make "management" an organizing concept.

This can be communicated to the student, as it has been in biology, in the form of a question. Two questions, in fact, should be asked by the student in every learning experience: "What can I learn about this that will help me to manage it better?" and, "How can better management of this contribute to a more satisfying personal and family life?" These are questions that the student can learn to use outside of school as well.

As important as building this "hierarchical" concept of management from experience in three appropriate subject matter areas, is increasing the ability to use nominal, or class concepts that are the tools of subject matter. Verbal symbols are often confounded by at least double and triple meanings and ability to perceive the requirements of the context is necessary for their correct use. In classes where students are frequently of below-average IQ, it is even more essential that these meanings be clear and concise. A student instructed to "fold" the beaten egg whites into the batter may be at a complete loss, if she only knows about placing the center front on the "fold" from her clothing course. A list of overlapping terminology in the various areas of home economics would be very long. An occasional vocabulary check-up would serve to inform the teacher whether or not she and her students were talking about the same thing. This role of correct concepts in communication has, of course, been emphasized.

A similar problem exists for a class concept such as "protein", which, although it is consistent from one context to another, does not appear to be so, as is illustrated in the following diagram:



For still other concepts, the problem is one of adding to an every-day meaning of the word. The common sense meaning may tend to stick. For example, if the student's common sense concept of "value", as the price or worth of something is maintained despite the teacher's efforts, in a discussion of family values, the student will certainly get a distorted concept of family values.

3. Implementation of the "Overview" Period

"Organization" is the portion of the concept of management which can be most easily conveyed in simple and concrete experiences. "Organization" is an abstraction; it is an idea with which we classify that which exists apart from the situations which we are classifying. However, the "clues" which we use to determine whether "organization" is or is not present in a situation can be largely perceptual.

The teacher might use the following approach, which requires perception, abstraction, and generalization of the students, guided by the teacher.

Negative instances are employed to make the concept more meaningful. The concept is used in several contexts,and experiences are included for the application of the concept by the student. The experiences are listed in approximation of daily plans.

1. The teacher demonstrates making biscuits, or some other simple product which all the students have made before, perhaps in junior high school classes. The demonstration includes getting all needed equipment and supplies together and all but actually washing the dishes and cleaning up. The teacher is "well-organized", and makes certain that the demonstration illustrates this by using a list of points prepared by the curriculum group.* The students are given instructions to watch the demonstration closely and to list all the things the teacher did to make her work easier, faster, and better. This list is to be as long as possible.
   After the demonstration, students compare their lists with one the teacher has.* The students will realize that there were many points they did not notice.

2. Using the list of all those things the teacher did in organizing her work, the students group the points which seem most similar, thus arriving at some principles. Compare these with the principles given in the text. * (The two lists of principles should be somewhat dissimilar, or the students will only feel that they are being manipulated into a prescribed "discovery". Also, this approach is intended to increase flexibility of thinking. The somewhat dissimilar lists should be compared for what they have in common, and approximations in wordings and ideas should be accepted as such.)

3. The teacher demonstrates salad-making. She announces that she is going to exhibit a lack of organization in making these salads. Students are to watch closely, and, as before, make a list, this time of all the things the teacher did which made her work more difficult and confused. The students again compare their observations with a list the teacher has used in planning her demonstration. Students decide by discussion which principles are violated by each point. Then, they might compare the two demonstrations using the question, "Why is good organization important to a person, and to a family?"

4. Compare the types of equipment and supplies used in the two demonstrations. Where, in relation to each other, were they stored? Students learn that planning is essential to good organization. They work in groups and plan the organization of a laboratory period, as guided by a laboratory manual.* The experiment will be a simple recipe. There are certain to be many questions, about how to organize, perhaps, but about specific skills needed as well. The teacher can then act upon the students' expressed needs and use the following day in a review of fundamental kitchen skills.

* An asterisk will indicate material that could be made available as part of the curriculum.

5. Students add to their concept of organization the idea that skills are essential in good organization. Students who think they are skillful can be called upon to give short demonstrations of measuring, reading a recipe, sifting, using equipment, etc. In this way, the teacher can check and correct errors. A review of safety rules is essential, too, before the students are allowed to cook. Emphasis should be on the idea that good organization reduces the chance for accidents.

6. One half of the students in each group make cookies. The others observe, using a list of questions in the lab manual which ask for evaluation of partners' work in terms of plans, suggestions for better organization, reasons why good organization is important in the school laboratory, and which introduce the idea of storage at the place of first use.

7. Students discuss the previous day's laboratory, using the observers' notes. They learn how evaluation is helpful in improving organization by evaluating the dishwashing and clean-up in the laboratory period the day before, and answering a question such as, "How could better organization in dishwashing have saved time and tempers?"

8. Students plan a routine for clean-up, guided by a sheet which asks questions which help them apply the principles set forth earlier and which introduces the idea of having standards by which to judge organization.* They learn that better organization is achieved by reducing to a routine those tasks which are repetitive. They also develop the idea that "storage at the place of first use favors food preparation jobs over clean-up jobs. Preparation is more complicated and attention-demanding than clean-up and is less routine." (87: 5)

9. Kitchens can be well-organized, too. The class makes a list on the board of all the activities that normally go on in a kitchen. The list will probably include both very specific activities such as "making cookies", and more general phrases; "baking" or "dishwashing". Students group the activities which seem to take place in the same areas in a kitchen. Discuss the arrangement of the kitchen "centers" which result from the grouping and relate the idea of storage at the place of first use. Apply at school, home, commercial establishment.

10. Students visit the school cafeteria, then evaluate the arrangement in terms of organization.

11. Use film of women working in kitchens with varying degrees of efficiency.* Students decide in which cases this is the inefficiency of the worker, or the work area, or lack of some other "resources". Students answer, "How do you decide whether a task is performed in an organized way or not?" The film adds the idea that as well as being stored at the place of first use, objects should be stored at various degrees of arm reach, depending on the nature of the object and the frequency of its use.

12. Students discuss, "Is there any thing you have learned about organization that applies to the way in which you get off to school in the morning?" "Why is this important to you and your family?" "How could you make an easier, faster and better job of it?" Storage of clothing can be organized in the same way as storage of kitchen equipment and supplies.

13. Students use textbook which offers many diagrams, sketches, charts, etc., as examples of the use of the concept "organization" in foods, clothing and housing.* The students are asked to solve some problems using the principles of organization they have worked previously.

14. Students begin collecting "short-cuts," "time-saving ideas," etc. from relatives, newspapers, and magazines, and bring them to class for evaluation; it will be possible to try some of these "helpful hints" to see if they really are, as the course work permits. Students analyze them in terms of their concept or organization to discover what it is that is being organized and why the "hint" might or might not work.

15. Use a filmstrip* which describes the vertical structure of the concept "management" in simple terms, using "organization" as the basis. Use of a filmstrip allows pacing of the frames with which the concept is being built. This strip might also describe a "concept" and its values to the student in learning (again using "organization" as an example), how the student can best approach the subject matter, and what is expected of her as an outcome of this type of learning. "The shortcomings of concepts based upon everyday experiences"are also pointed out. (6: 153) Using a filmstrip of this sort prepared by the curriculum group to communicate the goals of the group directly to the students will enable a more reliable evaluation of a new program as will give all the same "set" for conceptual learning.

Decision making cannot be made concrete in classroom experience as easily as "organization". It is not normally an observable process in everyday life; it can be inferred from observation, but not as directly as can "organization". Decision making is a more abstract process, superimposed, in a way, on the processes of organization. The ability to organize in order to increase satisfaction in personal and family life rests on the ability to make good decisions. In the development of the concept of decision-making, the concept, organization, too, grows in meaning.

Following are some concrete experiences in which the concept of "decision making" (briefly introduced in the filmstrip described previously)is gradually developed by the students:

16. Class lists on board all the points they would consider in deciding whether to buy or make a dress. In a brainstorming session, they answer the teacher's question, "What are all the things you would consider if you were to make a really careful decision as to whether to buy or make this dress?" Students group the factors considered under appropriate headings (resources, time, money, skill, etc.; needs, desires, etc.) The teacher asks several individual students what their decisions would be, and what factors were most important in helping them decide this. She helps the class realize that different people can make different decisions in the same situation, and that the same decisions can arise in different ways. Students answer, "Can anybody see any other way we could group these factors?" (Decisions are based on both facts and on "what we feel" about a thing.)

17. Class reads textbook* and discusses a series of cases in the text which point out that the weight assigned to facts and to subjective factors depends upon what is being decided, and that in order to make a decision, one has to have available alternatives.

18. Teacher demonstrates, on two successive days, making a cake from a mix and making a cake from scratch. The students are told that they will have to decide which they wish to make. During the demonstrations, students gather facts about the two ways. Various students compare time, money, energy, skill, and panel judges the products.

19. Groups decide between the two alternatives, using programed material* which guides them through stages of 1) looking at the information available, 2) listing the resources they will have to consider, 3) defining their goals in making this cake: better product, learning experience, etc. 4) predicting the consequences of the two alternatives, and 5) making the decision.

20. Students plan the organization of the laboratory, listing in the manual* all the decisions they made in the course of this planning. Students then analyze several of these decisions in terms of what they concerned and how they were made.

21. Students make the cakes and answer, "What decisions did you have to make that you had not planned on?" "Were you able to make these decisions adequately?"

22. Students evaluate the organization, the products and the decisions that were made in planning and carrying out the laboratory. Students answer, "Why is it important to evaluate?" "What would you change if you were to do this again in school, at home?"

23. Students listen to tapes* of people verbalizing decisions; the tape is cut off before the decision is made. Situations could resemble the following: housewife and grocer, deciding about meat
    teenage and salesgirl, deciding upon a fabric
    father and real estate agent, talking about a house
    Students answer, "What resources did the person consider?"
    "What were his needs, and his interests?"
    "What steps did he take in making his decision?"
    "What decision do you think the person made?"
    The teacher resumes the tape to hear what the person decided.
    Students then discuss the following: "Was it a good decision, in your opinion?"
    "Why or why not?"
    "Can people make different decisions with the same information?"

24. Students read text*, which develops the idea that a homemaker makes many decisions, a large number of which are made about products and concern their selection, use, and care. The text contains many examples from which the student is led to generalize that knowing about the composition of a product helps in decisions about its selection, use, and care. Much of home economics courses deals with learning principles which enable us to know factors about selection, use, and care of a product by knowing its composition.

25. Students examine three sweaters, labeled as they might be found in a store.* These sweaters are the same color and price, but the labels indicate that they are of different fibers. Students choose the one they would buy, and give their reasons for their decision. The teacher helps the student see the process of finding information and making predictions from it that they have used in making their decision.

26. Use a film* comparing the consequences of acting on impulse versus making considered decisions, with emphasis on the increased maturity shown in the latter. The film introduces the idea of the importance of having goals which aid in making decisions that increase satisfaction in personal and family life.

27. Students use the textbook,* which presents "case studies" of indecisive persons and asks questions which lead the students to analyze each case and come to the conclusion that indecision is a matter of lack of real choices, information, goals, and that in some cases, it arises as a result of the size of the decision.

28. Use tapes* of several "family conferences", in which decisions are being made about a house, education, a car, a job, etc. Students answer, "What seemed of most importance to the family?"
"How did knowing their "values" and talking about them help them make their decision?"
"Would these decisions be right for everybody?"

Underlying the processes of organization and decision making is the even more abstract concept of "values". Students have already been introduced to the importance of values in making large decisions, and to the importance of goals in making lesser decisions and in organization. It is important to give some concreteness to the concept of "values", and also to distinguish its meaning from the common usage. This could be done by helping the student discriminate among three terms which belong in a hierarchical fashion, to the same concept.

29. Students used programed material,* in which a brief explanation of the difference between standard of living, goals, and values is followed by a series of statements expressing each of these, such as: "I've always thought that a family ought to have a dishwasher," (standard of living) as compared with, "We hope to be able to send Harry to college," (goals) and "What our family really feels important is a deep religious faith," (values). The student will respond after each such statement with the term he thinks it exemplifies, thus learning to differentiate among these concepts, which are increasingly "broad and comprehensive in nature." (81)

30. Use film of interviews with actual families,* in their own homes, about their goals and values. Students estimate the family's standard of living from the material good which can be seen in the film, and describe their goals and values from what is said in response to the interviewer. Compare those families who seem to have their goals and values more clearly defined with those who don't seem to know what they want or stand for.

31. Students are given an interview form* with the same questions asked of the families in the film. Using this form, they interview their own parents. Questions are included concerning how standard of living, goals, and values seem to be related, how they are formed, and their changing nature.

32. Use filmstrip* which summarizes the concept of management thus far developed and shows how the concept can be used in giving direction to the rest of the course, in which there will be increased emphasis on subject matter concepts.

33. Students' concepts are evaluated with a standardized test,* before continuing with the year's work.

After this period of "overview", the remainder of the course would be concerned with the application of management in the fields of foods, clothing, housing, and family health as is now planned in the proposed New York State curriculum. A concept of management has been developed through a series of experiences which have required perceptions, abstraction, and generalization of the students, at increasingly complex and abstract levels. It seems important that the concept of management be developed from the first from the kinds of experiences in which it is to be applicable, rather than from a series of lectures and discussions, from which the students may gain only verbalisms. If the teacher and the materials keep the two questions, "What can I learn about this that will help me to manage it better?" and "How can better management of this contribute to a more satisfying personal and family life?" the students should be able to perceive similarities in situations which make the concept applicable, and thus promote the further growth of the concept.

The suggestions offered are by no means complete; they are intended to demonstrate the extent to which the "concept approach" to curriculum can be a fruitful one. Several problems, not within the scope of this paper, have been overlooked. These include the teacher's loss of individuality in using the curriculum and the very crucial question of financial support for so large an undertaking. As for the first, any curriculum should sell itself. Gradual development of the materials over a period of years might be a solution for the second.

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